FINAL REPORT ON THE

WINTER 1981 TRAFFICABILITY TESTS OF THE USCGC POLAR SEA

ICE INDUCED VIBRATION MEASUREMENTS AND DEVELOPMENT OF A MODEL FOR ICEBREAKING EXCITATION FORCES

VOLUME IXC - RECORDS AND DATA

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by

I.F. Glen
I. Majid
G. Tam
B. Menon

Submitted to

TRANSPORTATION DEVELOPMENT CENTRE
1000 Sherbrooke Street, West
Montreal, Quebec, H3A 2R3

Submitted by

ARCTEC CANADA LIMITED
311 Leggett Drive
Kanata, Ontario, K2K 1Z8

The Project Team consisted of:

°I. Glen
°I. Majid
°B. Menon
°G. Tam
°D. Blair

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17. Abstract

The vibratory response of the USCGC POLAR SEA to ice induced loads during the trafficability tests of winter 1981 is presented. Vibratory trials were carried out from 6 January to 11 February 1981. The data recorded on magnetic and video tapes consists of vertical, athwartship and fore and aft accelerations at various locations within the ship, strain measurements at frames 161 and 171, ship's speed, ice conditions, etc. Post trail analysis includes calculation of the fundamental frequencies of the hull girder up to the 5th and 6th modes, comparison of calculated frequencies with those recorded by the accelerometers, assessing the propulsion train vibrations in the longitudinal mode and formulation of a mathematical model for extracting the forcing function causing the ship board vibrations. A procedure for retrieving the raw data collected during the trails is also presented.

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K2K 1Z8

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17. Résumé

Ce rapport décrit le comportement vibratoire sous l'action des glaces de la coque du brise-glace américain Polar Sea lors de son périple dans les glaces arctiques durant la période du 6 janvier au 11 février 1981. Les données recueillies lors des essais du comportement vibratoire ont été enregistrées sur bandes magnétiques et vidéo, notamment les accélérations verticales, longitudinales et transversales en divers endroits de la coque, les déformations au droit des membrures 161 et 171, les vitesses, les conditions de glace, etc. L'analyse qui a suivi ces essais comporte le calcul des fréquences de résonance de la coque jusqu'au 5e et 6e modes de vibration, la comparaison des fréquences calculées et celles effectivement enregistrées, l'évaluation des vibrations longitudinales du système de propulsion et d'entraînement du navire et l'élaboration d'un modèle mathématique permettant de connaître les fonctions sous lesquelles se présentent les forces variables à l'origine des vibrations ressenties à bord. Enfin, une méthode permettant de se retrouver dans la masse de données brutes recueillies à bord est présentée dans le rapport.

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ANNEX 1

INPUT DATA FOR GBRP

NOTATION

Symbols	Definitions	Dimensions
A'	Cross-sectional area of longitudinal structural members from keel to main deck, carrying the shear stress for horizontal and vertical vibration	ft^2
A'_H	Sum of "A'" for horizontal vibration; cross-sectional area of decks and bottom platings	ft^2
A'_V	Sum of "A'" for vertical vibration; cross-sectional area of side (shell) plating and continuous longitudinal bulkheads	ft^2
a	Beam of main deck at cross section considered	ft
a_p	Area of deck or shell plating	ft^2
a_s	Area of stiffeners	ft^2
B	Maximum molded beam of the ship at the waterline; for a new design, the waterline refers to the design waterline, otherwise to the waterline of the given condition	ft
b	Half beam at the waterline of cross section considered	ft
C_H	Virtual mass coefficient for horizontal motion	--
C_V	Virtual mass coefficient for vertical motion	--
d	Distance of the neutral axis to the assumed x-axis (torsional vibration)	ft
d'	Distance of center of rudder area from assumed x-axis	ft
d_p	Distance from center of gravity of deck or shell plate to reference axis	ft
d_g	Distance from the vertical neutral axis of the ship, to the reference axis	ft
d_s	Distance from the center of each stiffener to the true neutral axis in vertical and horizontal vibration	ft
E	Young's modulus of elasticity; for shipbuilding steel: 1.93×10^6 or 1.34×10^4	ton/ft^2 ton/in^2
EI	Bending (flexural) rigidity of the hull	$ton\text{-}ft^2$

F_o	Enclosed area of the cross section of the station considered	ft^2
G	Modulus of elasticity in shear; for shipbuilding steel:	
	or 7.72×10^5	ton/ft^2
	5.36×10^3	ton/in^2
GJ_e	Torsional rigidity	$ton\text{-}ft^2$
H	The depth of the ship at midships, measured at the side from the baseline to the top of the uppermost strength deck	ft
h	Width of a shell plate (Note: width of deck plate is w)	ft
I	Area moment of inertia of cross section considered about a principal axis perpendicular to the plane of bending	in^2ft^2
I_o	Area moment of inertia of a plate about an axis through its center of gravity and parallel to the ship neutral axis for vertical and horizontal vibration	in^2ft^2
I_H	Area moment of inertia of a hull section for horizontal vibration	in^2ft^2
I_V	Area moment of inertia of a hull section for vertical vibration	in^2ft^2
I_p	Area moment of inertia of deck and shell plating about the true neutral axis	in^2ft^2
I_s	Area moment of inertia of stiffners about the true neutral axis	in^2ft^2
I_{mx}	Mass moment of inertia of a hull section about an axis through its center of gravity parallel to the x-axis (torsional direction)	$ft\text{-}ton\text{-}sec^2$
I_{mz}	Mass moment of inertia of a hull section about an axis through its center of gravity parallel to the z-axis (horizontal direction)	$ft\text{-}ton\text{-}sec^2$
J	Taylor's longitudinal inertia coefficient	ft^4
J_e	Effective area polar moment of inertia of a hull section	ft^4
K	Numerical factor determining shear rigidity for a hull section dependent upon the geometry of the cross section; $K \leq 1$	--
KA_H	Horizontal shear area	ft^2

KA_V	Vertical shear area	ft^2
KAG	Shear rigidity	tons
L_{pp}	Length of the ship between perpendiculars	ft
M	Bending moment of a hull section in flexural vibration	ton-ft
m	Mass of a hull section or of the rudder	$ton\text{-}sec^2/ft$
m_{vR}	Virtual mass of the rudder	$ton\text{-}sec^2/ft$
P	External driving force	tons
Q	External driving torque	ton-ft
R	Radius of gyration of a cross section at half station	ft
r	Radius of gyration of a section for calculation of I_{mz} $\left(r = \sqrt{(a^2 + \Delta x^2) / 12}\right)$	ft
S	Cross-sectional area below the waterline	ft^2
T	Draft of the ship at sections considered	ft
t	Time	sec
t	Thickness of a deck plate or shell plate	ft
V	Net shear force on ship sections in flexural vibration; negative when acting towards negative x, positive in the opposite direction to y	tons
w	Width of a deck plate (Note: width of shell plate is h)	ft
x	Displacement of a hull section along the length of the ship (x-axis)	mils
x'	Width of rudder measured through its center of area parallel to its baseline	ft
y	Lateral deflection of hull section (y-axis)	mils
$\tilde{z}$	Term coupling the bending mass to the torsional mass moment of inertia; it is the distance from the horizontal neutral axis to the axis of rotation	ft
$\bar{z}$	Distance from the assumed x-axis to the centroid of the cross section; negative if centroid lies below the x-axis	ft

z'	Height of rudder measured through its center of area and perpendicular to its baseline	ft
z_{vH}	Radius of gyration for the virtual mass moment of inertia, necessary to calculate the coupling term $\bar{z}$	ft
Δx	Length of hull section ($L_{pp}/20$)	ft
Δs	Length of an element of shell plating enclosing a section (to calculate effective polar moment of inertia of section area: J_e)	ft
λ	Ratio of draft to the half beam of the cross section at each station; for calculating virtual mass	--
μ	Mass per unit length of ship, including the virtual mass	ton-sec^2/ft^2
$\mu\Delta x$	Total section mass: $(\mu\Delta x)_h$; h stands for hull	ton-sec^2/ft
μ_{vH}	Virtual mass per unit length for horizontal vibration	ton-sec^2/ft^2
μ_{vV}	Virtual mass per unit length for vertical vibration	ton-sec^2/ft^2
ρ	Weight of sea water per cubic foot	ton/ft^3
ρ/g	Mass of sea water per cubic foot	ton-sec^2/ft^4
σ	Fullness coefficient of a cross section of the ship; for calculating virtual mass	--
ϕ	Rotational displacement of hull section about the x-axis (positive when rotating clockwise, looking toward bow)	radians
ν	Rotational displacement of the hull section about the z-axis (positive when rotating clockwise, looking down).	radians

TABLE 1

MASS DISTRIBUTION

STATION	WEIGHT (Tons)	$(\mu.\Delta x)h$ ton-sec²/ft	Scale of dwg 1"□ = 130.3674 tons
½	276.379	8.583	1.3 x .8 + .9 x 1.2
1½	365.685	11.357	.6 x 1.2 + .7 x 2.88
2½	495.605	15.391	1.32 x 2.88
3½	605.426	18.802	.15 x 2.88 + 1.17 x 3.6
4½	407.659	12.660	0.2 x 3.6 + 1.3 x 2.35
5½	921.306	28.612	.1 x 2.35 + 1.22 x 5.6
6½	834.873	25.928	.28 x 5.6 + 1.04 x 4.65
7½	720.150	22.365	.56 x 4.3 + .76 x 4.1
8½	705.548	21.911	1.32 x 4.1
9½	662.527	20.575	.22 x 4.1 + 1.1 x 3.8
10½	653.923	20.308	1.32 x 3.8
11½	661.641	20.548	.58 x 3.8 + .74 x 3.88
12½	651.107	20.221	.26 x 3.88 + 1.06 x 3.76
13½	651.576	20.235	.74 x 3.76 + .58 x 3.82
14½	657.365	20.415	1.32 x 3.82
15½	705.548	21.911	.9 x 3.82 + .42 x 4.7
16½	614.969	19.098	.48 x 4.7 + .84 x 2.93
17½	451.175	14.012	.96 x 2.93 + .36 x 1.8
18½	380.151	11.806	.24 x 1.8 + 1.08 x 2.3
19½	769.298	23.891	1.42 x 2.3 + 1.9 x 1.3 + .3 x .55

LOAD CONDITION	Δ(Tons)	Draught(F)	Draught(A)	Draught(A)
Full Load #2 (given) Full Load # 3 (given)	13016 11562	32'-0" 29'-0"	31'-44" 28'-11"	30'-8.8" 28'-10.2"
Calculated Loading (By direct interpolation)	12192	30'-3.6"	29'-11.7"	29'-7.9"

* Scale of dwg 1" = 130.3674 tons

VIRTUAL MASS DISTRIBUTION (1 of 2)
TABLE 2

STATION NO.	b (ft)	T (ft)	λ (=T/b)	b x T (ft^2)	S/2 (ft^2)	σ (=s/2bt)	C_V	C_H
(A.P.) 0	1.875	29.580	15.776	55.463	1.481	0.027	0.7522	0.4000
1	11.500	29.635	2.577	340.803	45.500	0.134	0.7522	0.4348
2	19.438	39.670	1.526	576.725	169.914	0.299	0.7522	0.4913
3	25.500	29.710	1.165	757.605	333.501	0.440	0.7565	0.4739
4	29.750	29.745	1.000	884.914	447.380	0.506	0.7913	0.4565
5	32.750	29.782	0.909	975.361	648.991	0.678	0.8826	0.4565
6	35.000	29.820	0.852	1043.700	804.315	0.771	0.9957	0.4478
7	36.625	29.860	0.815	1093.623	920.939	0.842	1.0913	0.4061
8	37.313	29.900	0.801	1115.659	1002.124	0.898	1.1609	0.4217
9	38.375	29.935	0.780	1148.756	1060.661	0.923	1.1957	0.4304
10	39.000	29.975	0.769	1169.025	1088.751	0.931	1.2000	0.4348
11	39.438	30.015	0.761	1183.732	1089.641	0.921	1.1870	0.4348
12	39.438	30.055	0.762	1185.309	1070.652	0.903	1.1522	0.4217
13	39.125	30.095	0.769	1177.467	1032.475	0.877	1.1348	0.4130
14	37.900	30.135	0.795	1142.117	960.491	0.841	1.1000	0.4061
15	35.750	30.160	0.844	1078.220	864.033	0.801	1.0200	0.4026
16	32.188	30.220	0.939	972.721	712.635	0.733	0.9435	0.4043
17	27.125	30.255	1.115	820.667	480.708	0.586	0.8609	0.4304
18	20.250	30.295	1.496	613.474	272.390	0.444	0.7522	0.4522
19	12.625	30.335	2.403	382.797	100.067	0.261	0.7522	0.4565
(F.P.)20	4.000	30.375	7.594	121.500	4.750	0.039	0.7522	0.4000

$\frac{L}{B} = \frac{352}{78.876} = 4.463$ Therefore from Figure 13 the value of J = 0.60

$\frac{1}{2}\pi\ (\rho/g) = 0.0014$ ton-sec^2/ft^4

$\mu_{UV} = \frac{1}{2}\pi(\rho/g)\ J\ C_V\ b^2$ ton-sec^2/ft^2

and $\frac{1}{2}\pi(\rho/g)J = 0.00084$

S - Cross sectional area below WL of section considered Figure 9
b - Half-breadth at WL of section considered Figure 3
T - Draught at the cross section considered Figure 5

VIRTUAL MASS DISTRIBUTION (2 of 2)

TABLE 3 TABLE 4

STATION NO.	b^2 (ft^2)	C_V	$b^2 \times C_V$ (ft^2)	μ_{oV} (ton-sec^2/ft^2)	T^2 (ft^2)	C_H	$T^2 \times C_H$ (ft^2)	μ_{oH} (ton-sec^2/ft^2)
(A.P.) 0	3.516		2.6445	0.0022	874.98		349.99	0.2940
1	132.25		99.48	0.0836	878.23		381.86	0.3208
2	377.84		284.21	0.2387	880.31		432.50	0.3633
3	650.25		491.91	0.4132	882.68		418.30	0.3154
4	885.06		700.35	0.5883	884.77		403.90	0.3393
5	1072.56		946.64	0.7952	886.37		404.90	0.3401
6	1225.00		1219.73	1.0246	889.23		398.20	0.3345
7	1341.39		1463.86	1.2296	891.62		362.09	0.3042
8	1392.26		1616.27	1.3577	894.01		377.00	0.3167
9	1472.64		1760.84	1.4791	896.10		385.68	0.3240
10	1521.00		1825.20	1.5332	898.50		390.67	0.3282
11	1555.36		1846.21	1.5508	900.90		391.71	0.3290
12	1555.36		1792.08	1.5053	903.30		380.92	0.3200
13	1530.77		1737.11	1.4592	905.71		374.06	0.3142
14	1436.41		1580.05	1.3272	908.12		368.79	0.3098
15	1278.06		1303.62	1.0950	909.63		366.22	0.3076
16	1036.07		977.53	0.8211	913.25		369.23	0.3102
17	735.77		633.42	0.5321	915.37		393.97	0.3309
18	410.06		308.45	0.2591	917.79		415.02	0.3486
19	159.39		119.89	0.1007	920.21		420.08	0.3529
(F.P.)20	16.00		12.04	0.0101	922.64		369.06	0.3100

C_V and C_H obtained from figures 3 and 4 respectively of Reference 1.
b: ½ beam at section WL
T: Draught at section WL
S: Cross-sectional area below the WL
$\mu_{oH} = \frac{1}{2}\pi\left(\frac{\rho}{g}\right) JT^2C_H$

$\frac{1}{2}\pi\left(\frac{\rho}{g}\right) J = 0.00084$

TOTAL VIRTUAL MASS FOR VERTICAL AND HORIZONTAL VIBRATION

$\Delta x = 352 \div 20 = 17.60$ ft

TABLE 5

STATION NO.	μ_{oV} (ton-sec²/ft²)	$\mu_{oV} \times \Delta x$ (ton-sec²/ft)	μ_{oH} (ton-sec²/ft²)	$\mu_{oH} \times \Delta x$ (ton-sec²/ft)
½	0.03	0.528	0.295	5.192
1½	0.15	2.640	0.350	6.160
2½	0.32	5.632	0.360	6.336
3½	0.50	8.800	0.340	5.984
4½	0.69	12.144	0.340	5.984
5½	0.92	16.192	0.340	5.984
6½	1.135	19.975	0.320	5.632
7½	1.295	22.792	0.315	5.544
8½	1.42	24.992	0.320	5.632
9½	1.51	26.576	0.325	5.720
10½	1.55	27.280	0.330	5.808
11½	1.55	27.280	0.325	5.720
12½	1.533	26.981	0.320	5.632
13½	1.44	25.344	0.310	5.456
14½	1.20	21.120	0.305	5.368
15½	0.92	16.192	0.305	5.368
16½	0.67	11.792	0.315	5.544
17½	0.40	7.040	0.340	5.984
18½	0.18	3.168	0.345	6.072
19½	0.05	0.880	0.330	5.808

μ_{oV} and μ_{oH} obtained, for half-stations, from Figure 1.

BENDING COMPLIANCE FOR VERTICAL AND HORIZONTAL VIBRATION

$E = 1.93 \times 10^6$ tons/ft²; $\Delta x = 17.60$ ft TABLE 6

STATION NO.	I_V (ft⁴) x 10^4	EI_V (ft²-ton) x 10^9	$\Delta x/EI_V$ (1/ft.ton) x 10^{10}	I_H (ft⁴) x 10^4	EI_H (ft²-ton) x 10^{10}	$\Delta x/EI_H$ (1/ft.ton) x 10^{10}
	Figure 11			Figure 11		
½	0.53048	10.2383	17.19041	0.57876	11.17007	15.75639
1½	0.81983	15.8227	11.12325	1.01765	19.64070	8.96098
2½	0.94039	18.1495	9.96722	1.19610	23.08481	7.62406
3½	0.96933	18.7081	9.40771	1.30221	25.13265	7.00284
4½	0.97415	18.8011	9.36116	1.37456	26.52891	6.63427
5½	1.97656	18.8476	9.33805	1.46137	28.20442	6.24016
6½	0.97656	18.8476	9.33805	1.58677	30.62460	5.74701
7½	0.97656	18.8476	9.33805	1.72663	33.32404	5.28147
8½	0.97656	18.8476	9.33805	1.89544	36.58197	4.81111
9½	0.97656	18.8476	9.33805	2.12694	41.05000	4.28745
10½	0.97656	18.8476	9.33805	2.48385	47.93821	3.67139
11½	0.97656	18.8476	9.33805	2.98544	57.61893	3.05455
12½	0.96933	18.70807	9.40771	2.95650	57.06043	3.08445
13½	0.96692	18.6616	9.43115	2.54654	49.14830	3.58100
14½	0.96451	18.6150	9.45472	2.04978	39.56066	4.44886
15½	0.96451	18.6150	9.45472	1.64947	31.83469	5.52856
16½	0.95486	18.4288	9.55027	1.22987	23.73639	7.41477
17½	0.86806	16.7536	10.50523	0.84403	16.28968	10.80438
18½	0.64140	12.3790	14.21760	0.48230	9.30839	18.90767
19½	0.26042	5.0261	35.01717	0.16881	3.25794	54.02192

SHEAR COMPLIANCE FOR VERTICAL AND HORIZONTAL VIBRATION

$G = 7.72 \times 10^5 \text{ton/ft}^2$ $\Delta x = 17.6$ ft

TABLE 7

STATION NO.	A'_V (ft^2) Fig.10	$A'_V G$ (tons) $\times 10^6$	$(\Delta x/KAG)_V$ (ft/ton) $\times 10^{-6}$	A'_H (ft^2) Fig.10	$A'_H G$ (tons) $\times 10^6$	$(\Delta x/KAG)_H$ (ft/ton) $\times 10^{-6}$
0	.4785	.3694	47.6490	1.2303	.9498	18.5302
1	1.6678	1.2875	13.6698	3.5542	2.7439	6.4143
2	3.0074	2.3217	7.5805	5.6731	4.3796	4.0186
3	4.7846	3.6937	4.7649	7.7510	5.9838	2.9413
4	7.1768	5.5405	3.1766	9.7058	7.4929	2.3489
5	6.2199	4.8018	3.6659	11.8247	9.1287	1.9280
6	5.2357	4.0419	4.3543	10.5944	8.1789	2.1519
7	4.9213	3.7992	4.6325	9.8425	7.5984	2.3163
8	4.9896	3.8520	4.5691	10.2526	7.9150	2.2236
9	5.3040	4.0947	4.2902	11.0045	8.4955	2.0717
10	5.6321	4.3480	4.0479	11.1412	8.6010	2.0463
11	6.0149	4.6435	3.7903	12.7406	9.8357	1.7694
12	6.4660	4.9917	3.5258	12.5082	9.6563	1.8226
13	6.8351	5.2767	3.3354	12.1665	9.3925	1.8738
14	7.1358	5.5089	3.1949	13.5335	10.4478	1.6846
15	7.5186	5.8044	3.0322	16.8827	13.0334	1.3504
16	7.9560	6.1421	2.8655	13.0550	10.0785	1.7463
17	8.5439	6.5959	2.6683	10.8678	8.3899	2.0978
18	7.9771	6.1737	2.8508	8.8856	6.8597	2.5657
19	5.8782	4.5380	3.8984	6.4933	5.0129	3.5110
20	2.7340	2.1107	8.3386	3.3492	2.5856	6.8070

$KA = A'$

A'_V is the area of the vertical plating only of the station.
A'_H is the area of the horizontal plating only of the station.
A' is the total area of the cross-section at the station.
K a constant depending on the shape of the section.

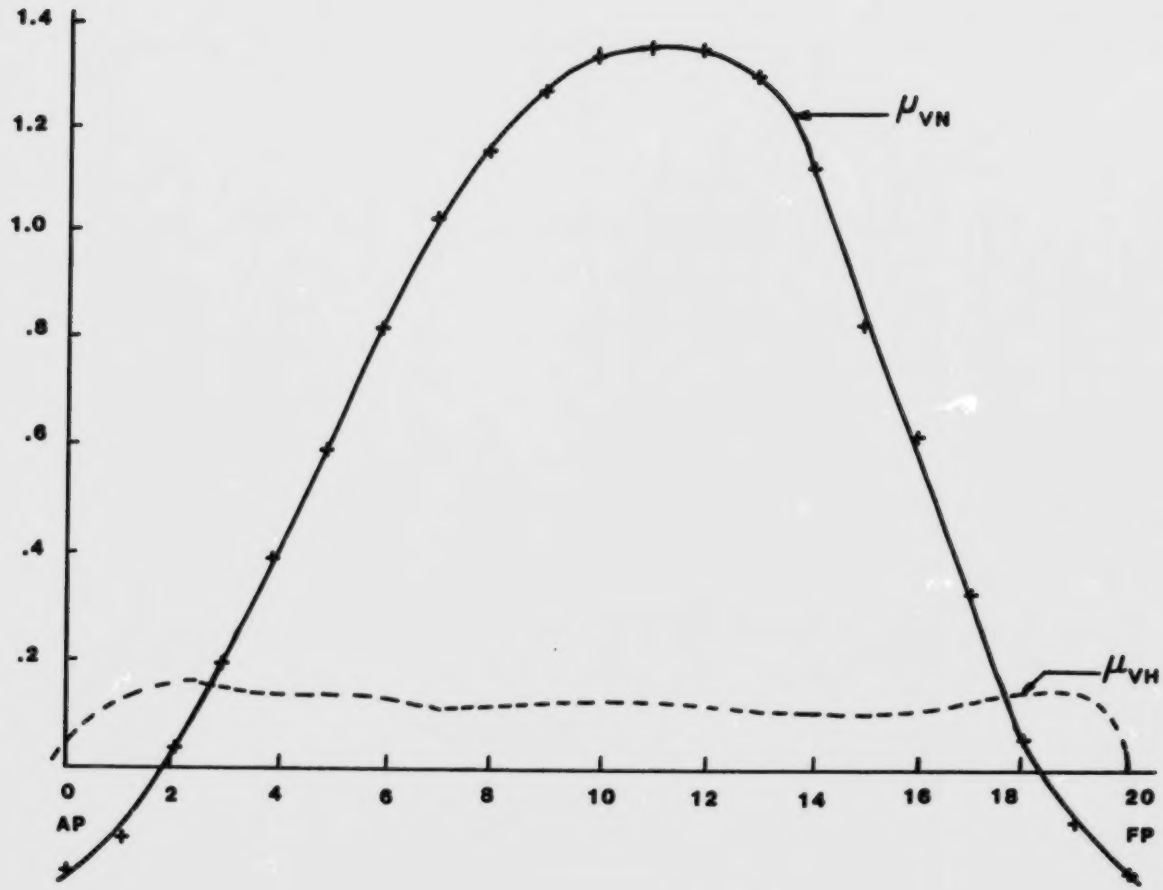


FIGURE 1

SHEAR COMPLIANCE FOR VERTICAL AND HORIZONTAL VIBRATION

$G = 7.72 \times 10^5 \text{ton/ft}^2$ $\Delta x = 17.6$ ft TABLE 7

STATION NO.	A'_V (ft^2) Fig.10	$A'_V G$ (tons) $\times 10^6$	$(\Delta x/KAG)_V$ (ft/ton) $\times 10^{-6}$	A'_H (ft^2) Fig.10	$A'_H G$ (tons) $\times 10^6$	$(\Delta x/KAG)_H$ (ft/ton) $\times 10^{-6}$
0	.4785	.3694	47.6490	1.2303	.9498	18.5302
1	1.6678	1.2875	13.6698	3.5542	2.7439	6.4143
2	3.0074	2.3217	7.5805	5.6731	4.3796	4.0186
3	4.7846	3.6937	4.7649	7.7510	5.9838	2.9413
4	7.1768	5.5405	3.1766	9.7058	7.4929	2.3489
5	6.2199	4.8018	3.6659	11.8247	9.1287	1.9280
6	5.2357	4.0419	4.3543	10.5944	8.1789	2.1519
7	4.9213	3.7992	4.6325	9.8425	7.5984	2.3163
8	4.9896	3.8520	4.5691	10.2526	7.9150	2.2236
9	5.3040	4.0947	4.2902	11.0045	8.4955	2.0717
10	5.6321	4.3480	4.0479	11.1412	8.6010	2.0463
11	6.0149	4.6435	3.7903	12.7406	9.8357	1.7694
12	6.4660	4.9917	3.5258	12.5082	9.6563	1.8226
13	6.8351	5.2767	3.3354	12.1665	9.3925	1.8738
14	7.1358	5.5089	3.1949	13.5335	10.4478	1.6846
15	7.5186	5.8044	3.0322	16.8827	13.0334	1.3504
16	7.9560	6.1421	2.8655	13.0550	10.0785	1.7463
17	8.5439	6.5959	2.6683	10.8678	8.3899	2.0978
18	7.9771	6.1737	2.8508	8.8856	6.8597	2.5657
19	5.8782	4.5380	3.8984	6.4933	5.0129	3.5110
20	2.7340	2.1107	8.3386	3.3492	2.5856	6.8070

$KA = A'$

A'_V is the area of the vertical plating only of the station.
A'_H is the area of the horizontal plating only of the station.
A' is the total area of the cross-section at the station.
K a constant depending on the shape of the section.

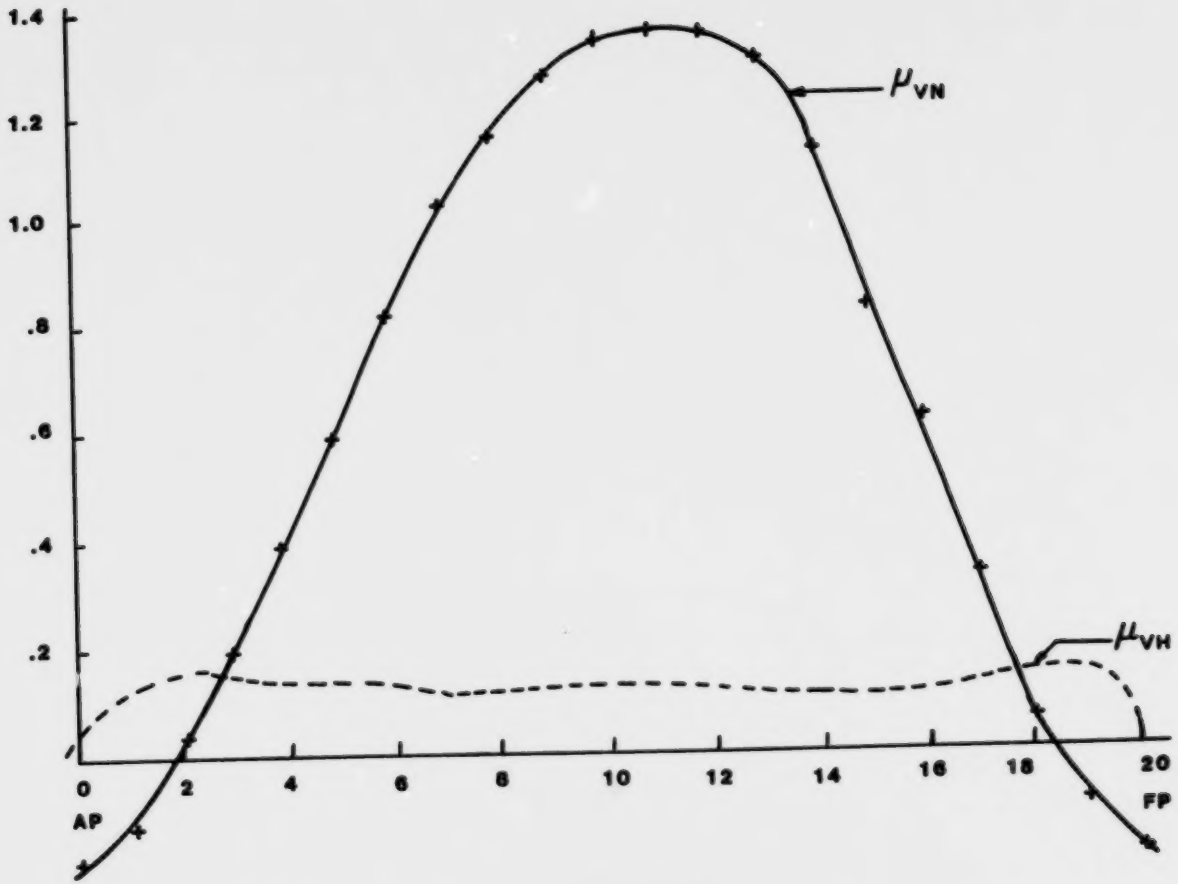


FIGURE 1

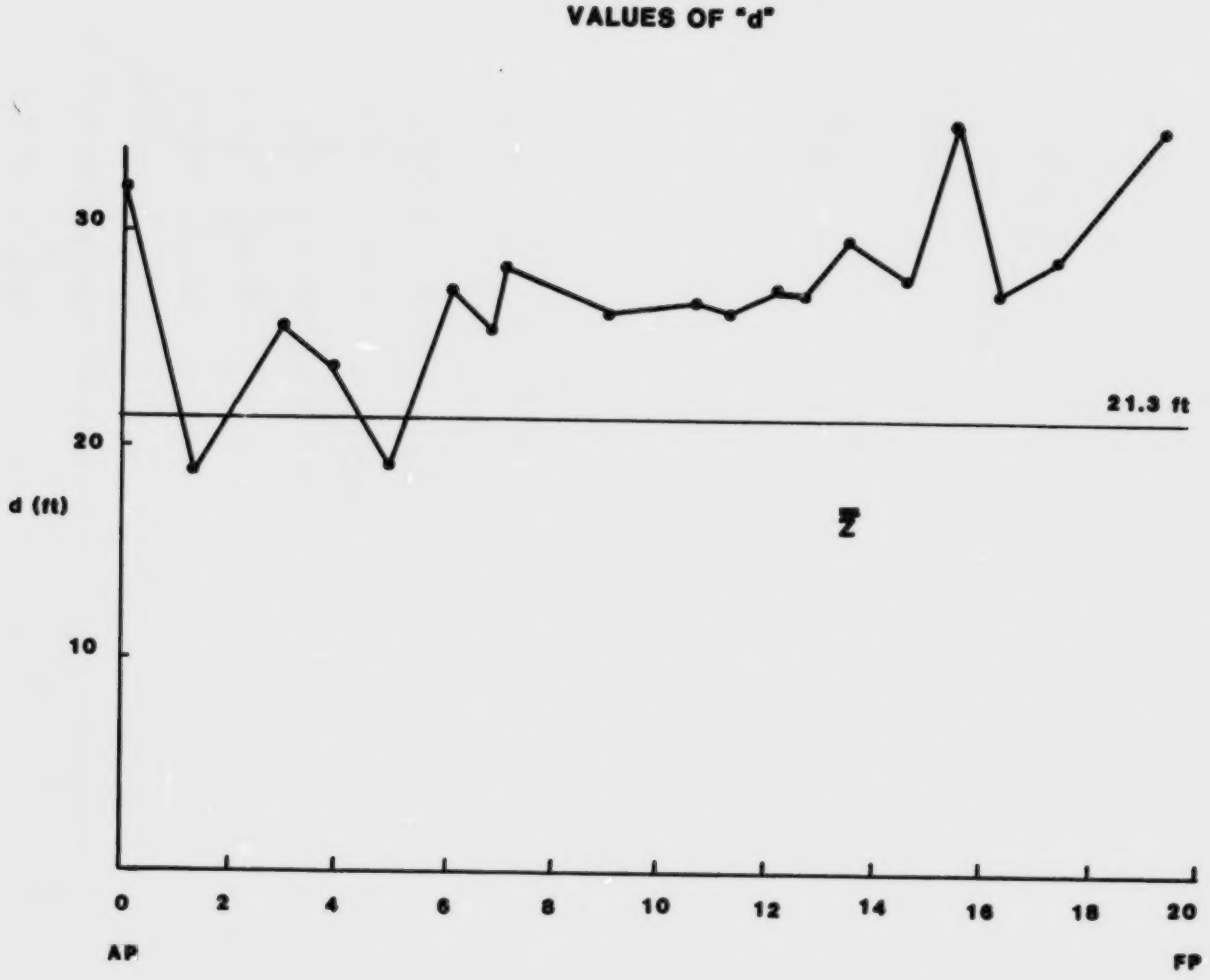


FIGURE 2

1/2 BEAM AT WL

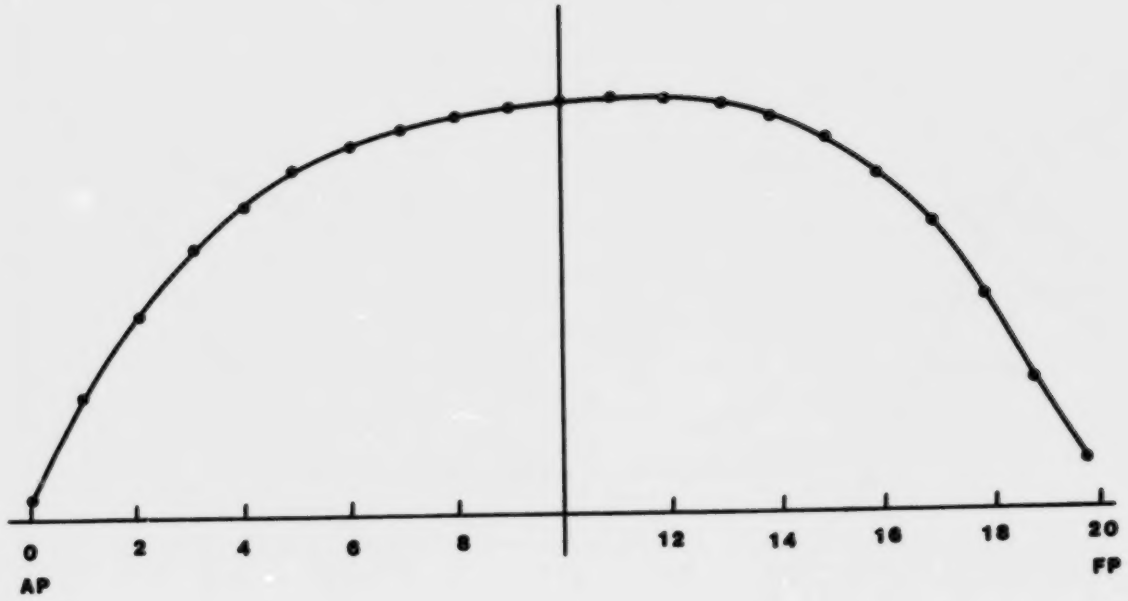


FIGURE 3

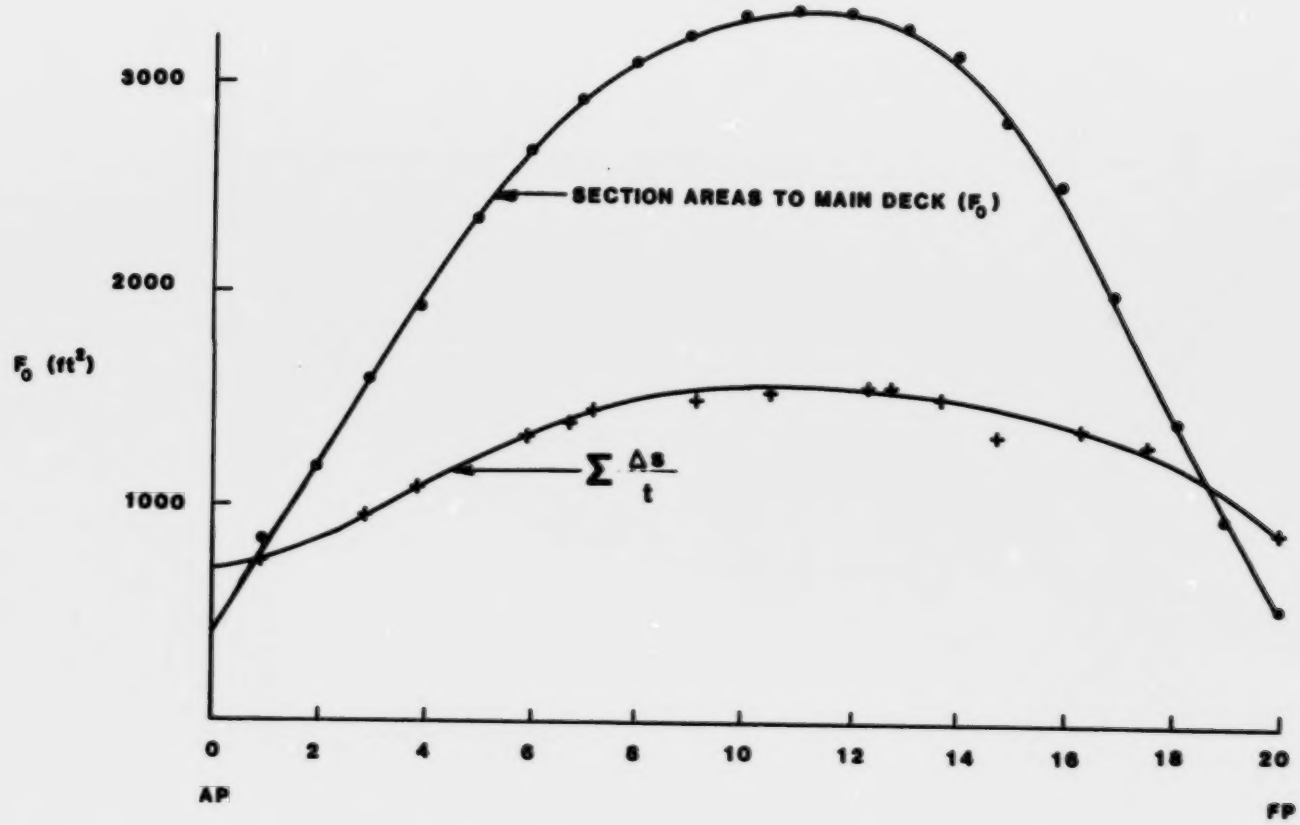

3000
2000
1000
F_0 (ft^2)
SECTION AREAS TO MAIN DECK (F_0)
$\sum \frac{\Delta s}{t}$
0
2
4
6
8
10
12
14
16
18
20
AP
FP

FIGURE 4

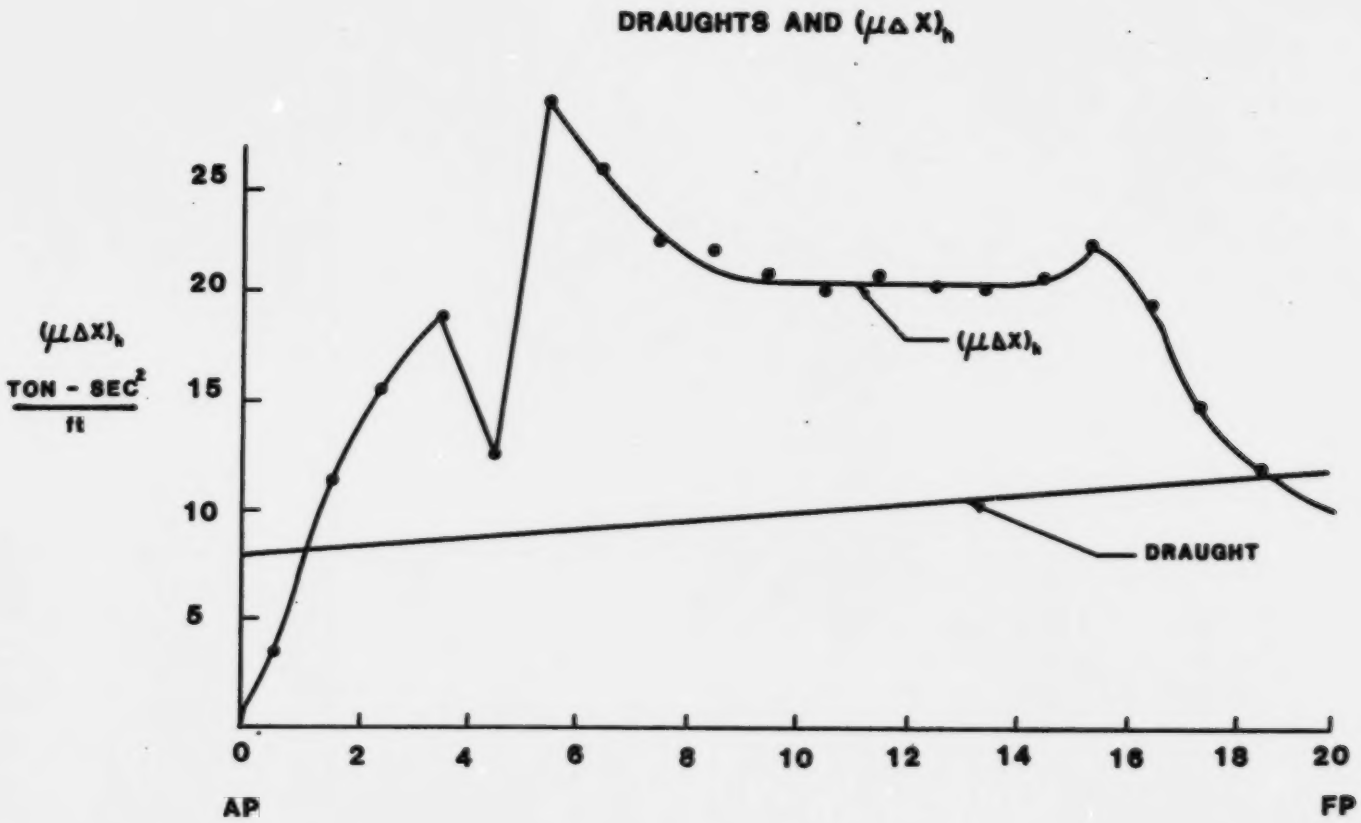
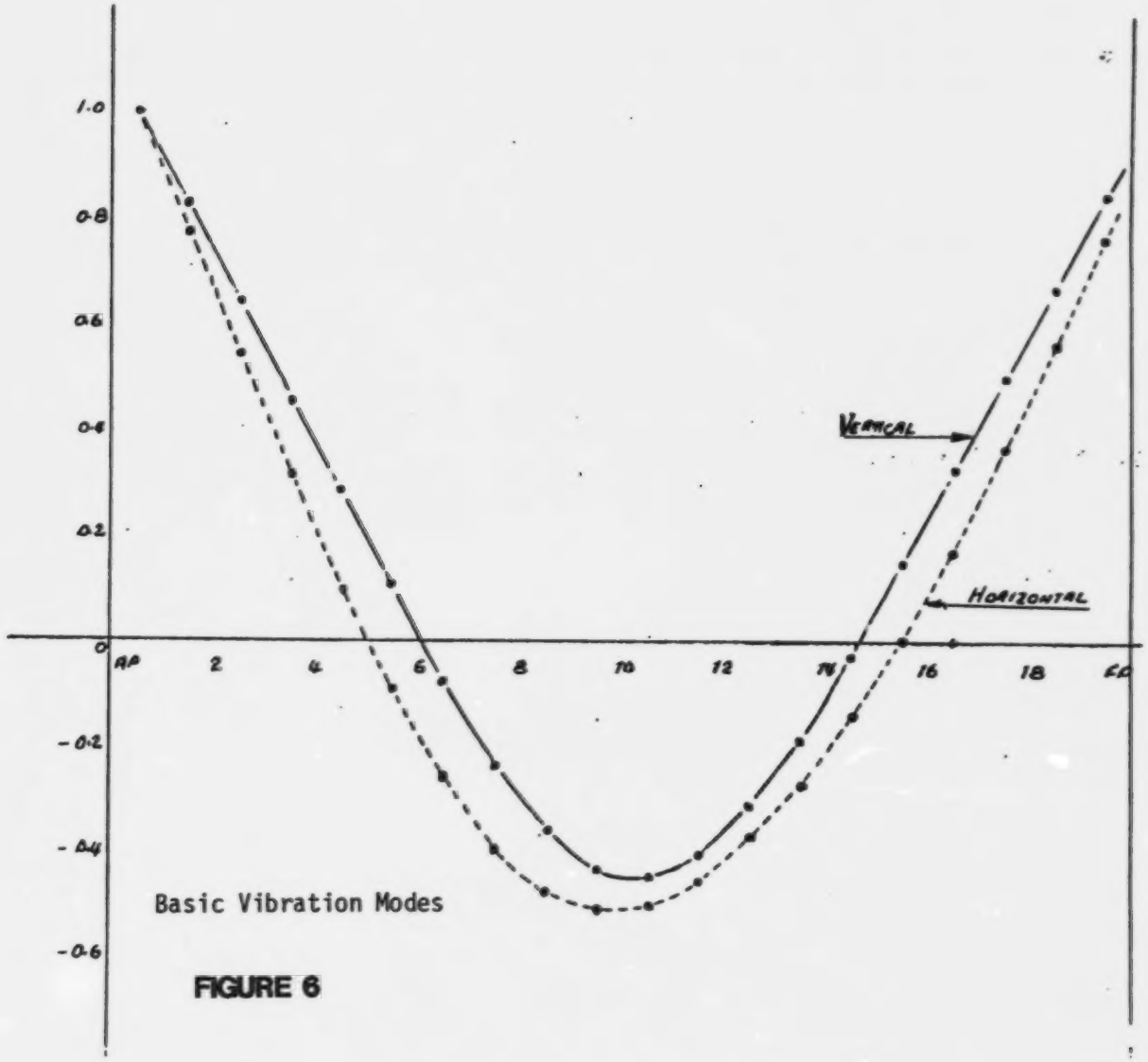
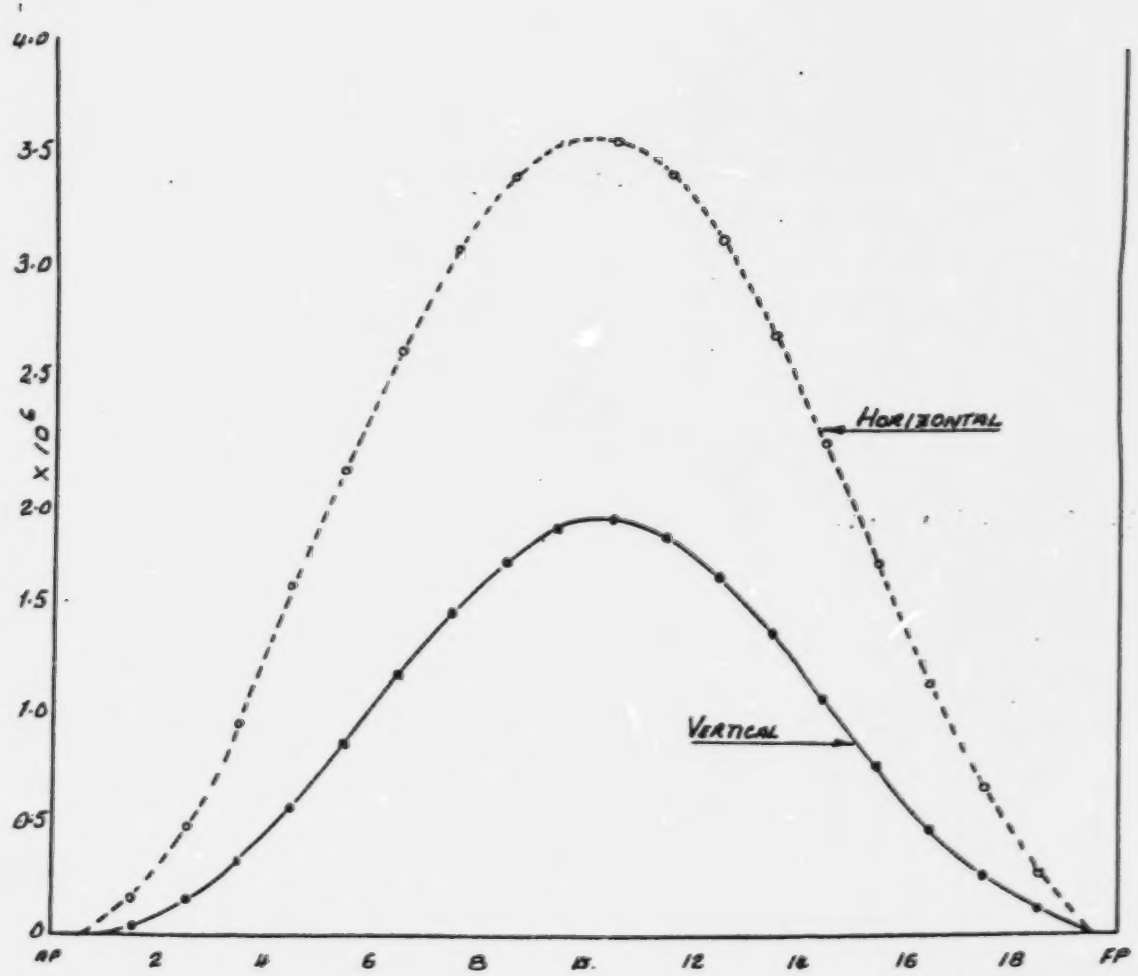

DRAUGHTS AND $(\mu\Delta X)_h$
$(\mu\Delta X)_h$
TON - SEC^2
ft
25
20
15
10
5
$(\mu\Delta X)_h$
DRAUGHT
0
2
4
6
8
10
12
14
16
18
20
AP
FP

FIGURE 5



Basic Vibration Modes

FIGURE 6



Bending Moment

FIGURE 7

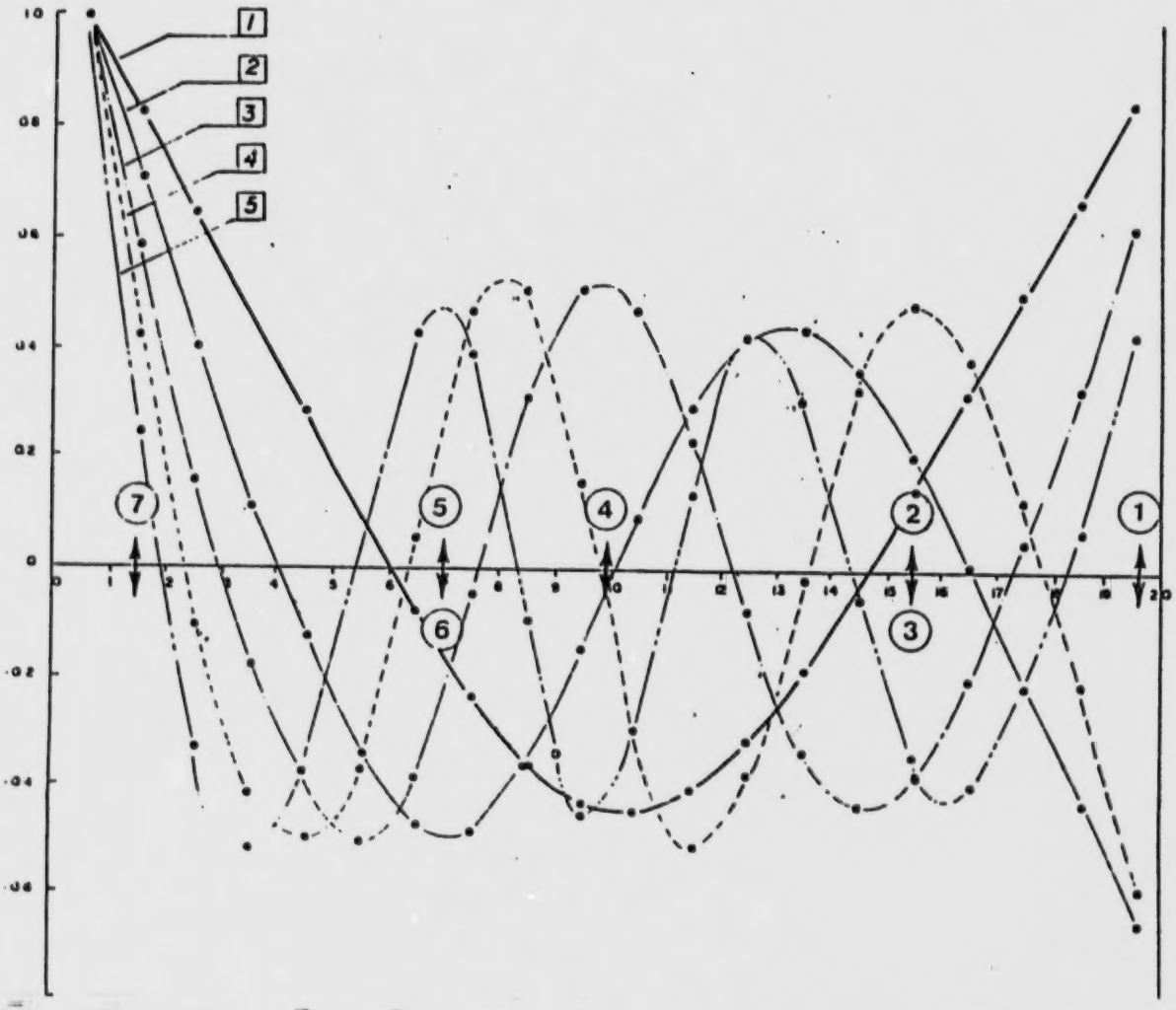


FIGURE 8A

FIRST FIVE MODE SHAPES OF VERTICAL VIBRATION

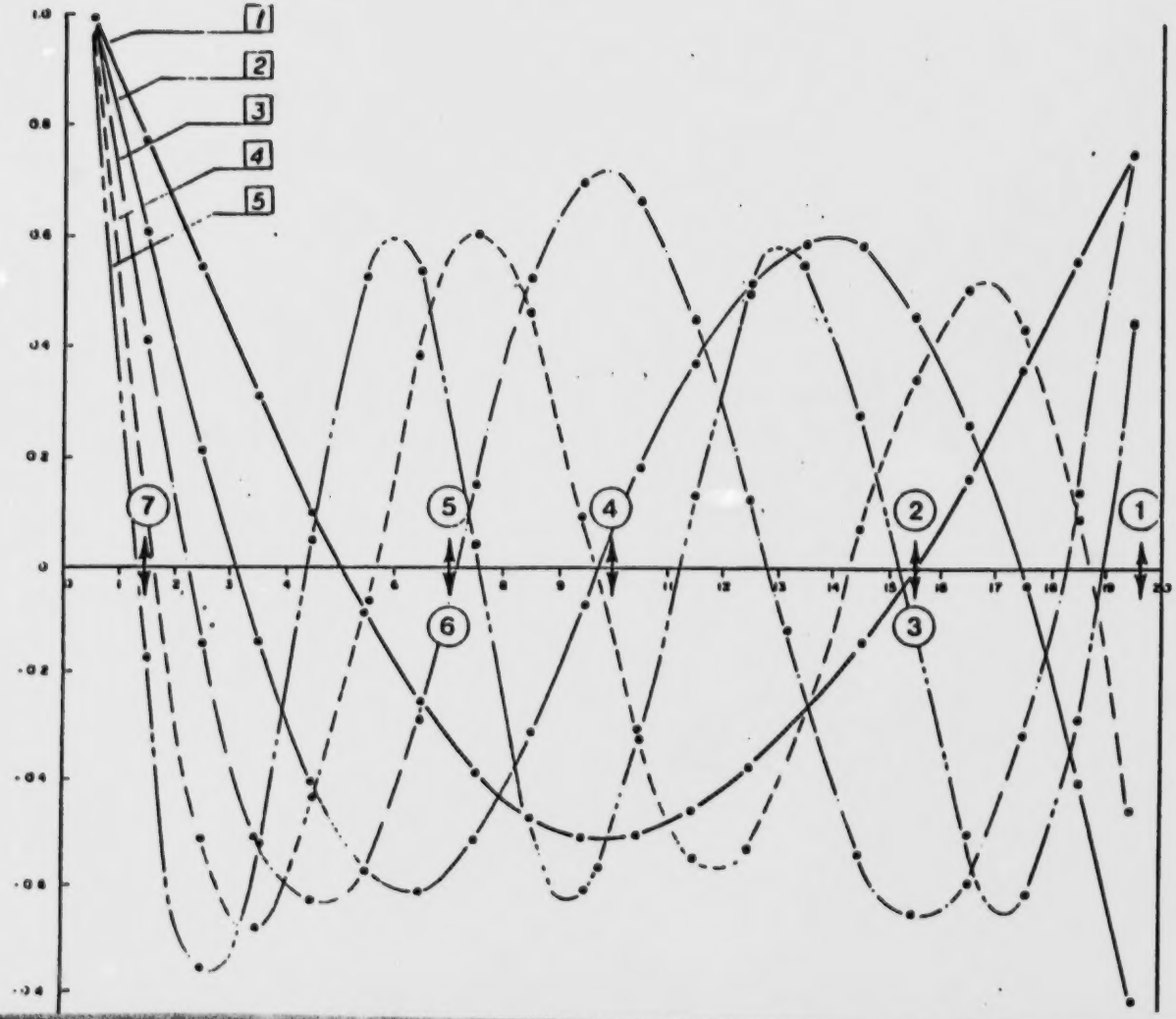


FIGURE 8B

FIRST FIVE MODE SHAPES OF HORIZONTAL VIBRATION

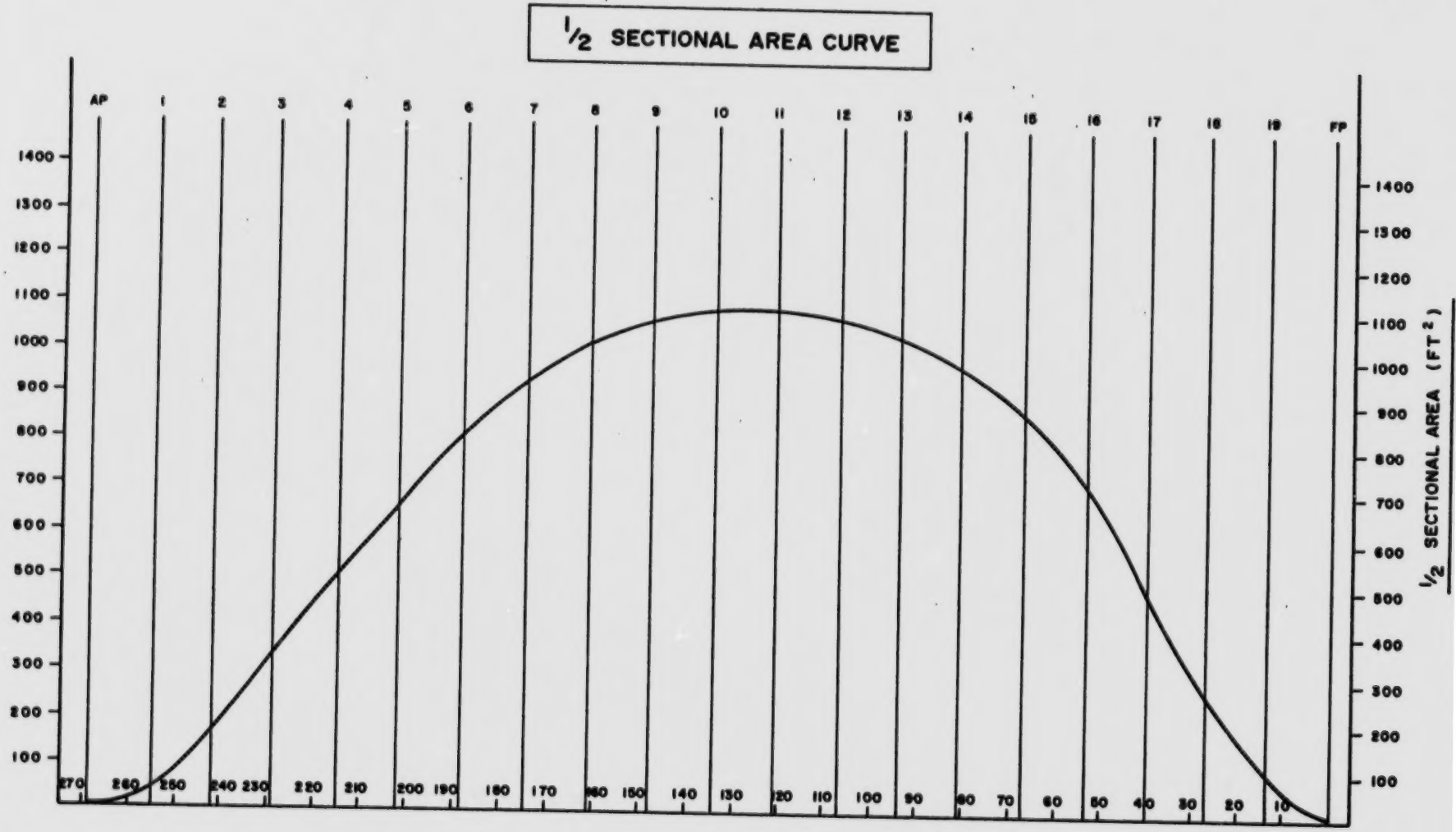

½ SECTIONAL AREA CURVE
AP
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
FP
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
½ SECTIONAL AREA (FT²)

FIGURE 9

HORIZONTAL AND VERTICAL PLATE AREAS

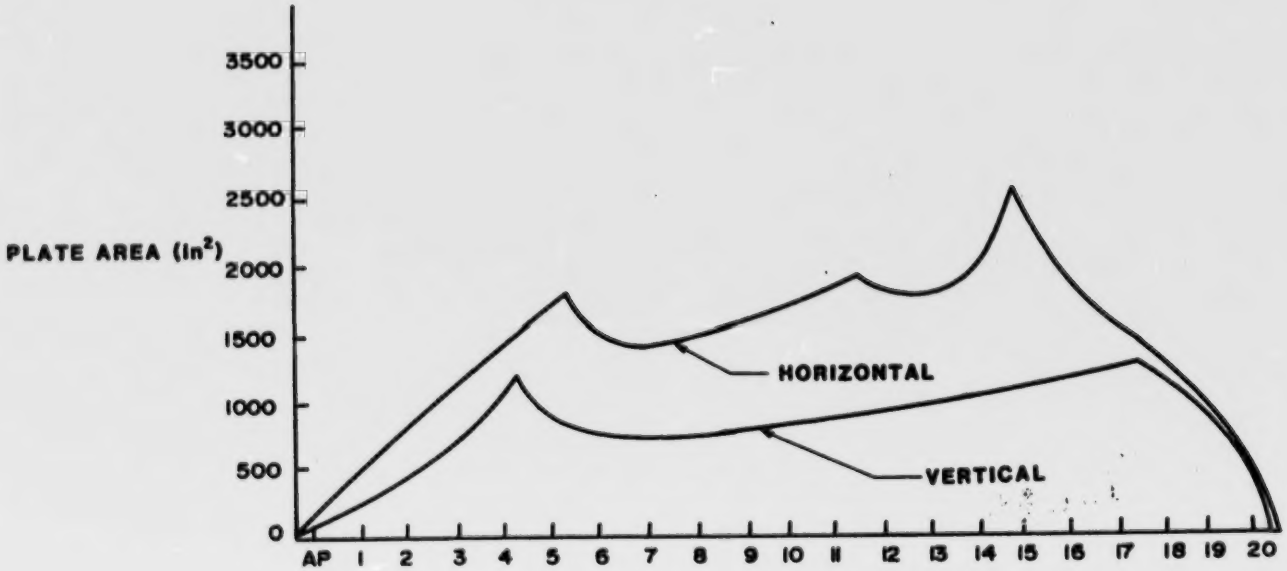


FIGURE 10

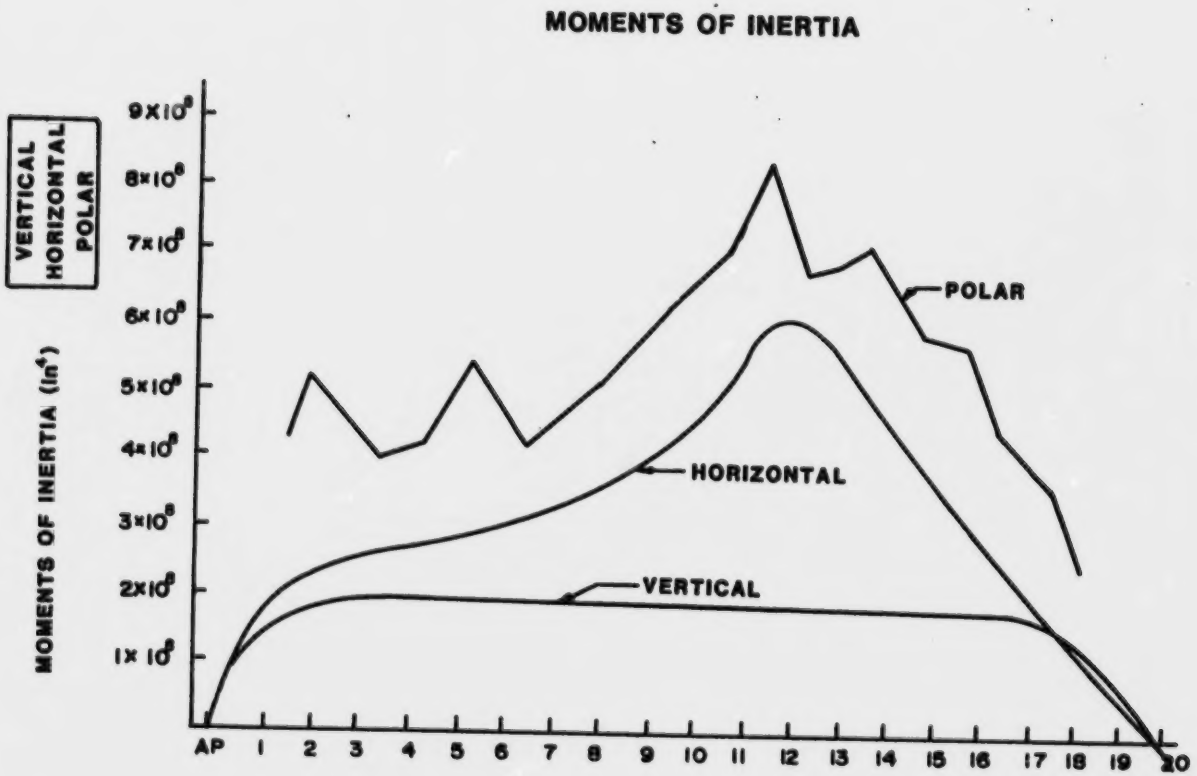

MOMENTS OF INERTIA
VERTICAL
HORIZONTAL
POLAR
MOMENTS OF INERTIA (in⁴)
9X10⁸
8X10⁸
7X10⁸
6X10⁸
5X10⁸
4X10⁸
3X10⁸
2X10⁸
1X10⁸
POLAR
HORIZONTAL
VERTICAL
AP 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

FIGURE 11

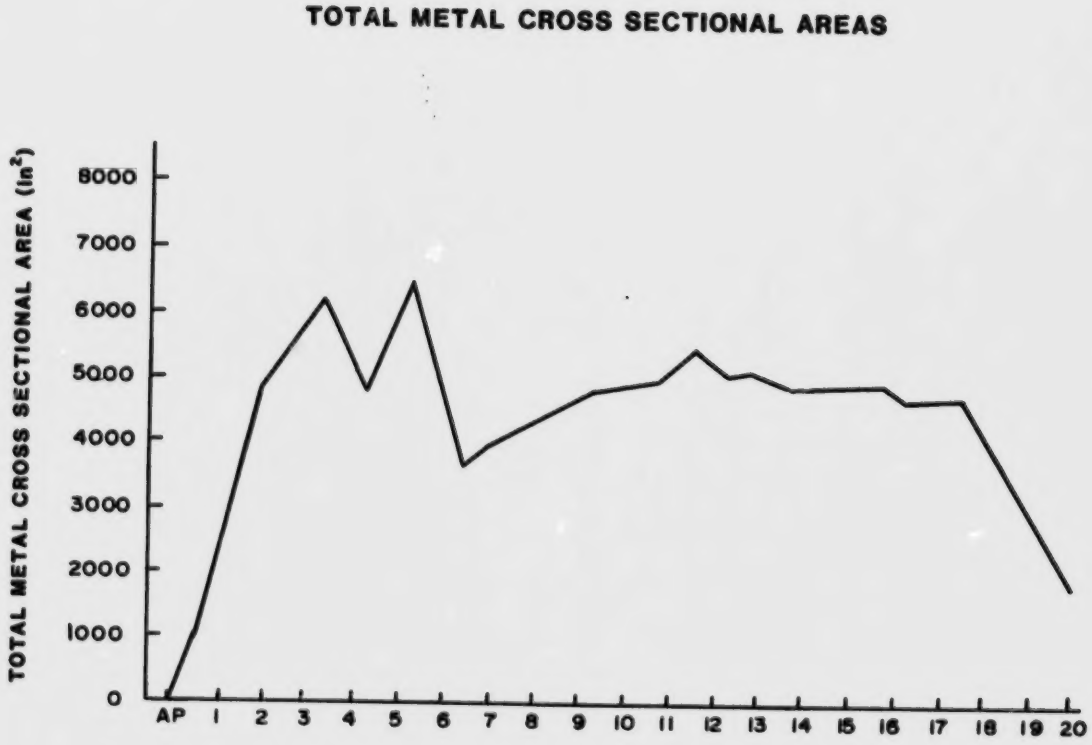

TOTAL METAL CROSS SECTIONAL AREAS
TOTAL METAL CROSS SECTIONAL AREA (in²)
8000
7000
6000
5000
4000
3000
2000
1000
0
AP 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

FIGURE 12

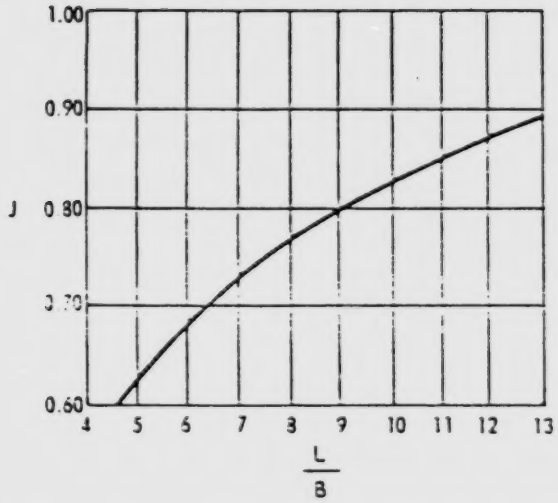


Figure 13 - Curve for Obtaining Taylor's Coefficient J
Used in Virtual Mass Estimate

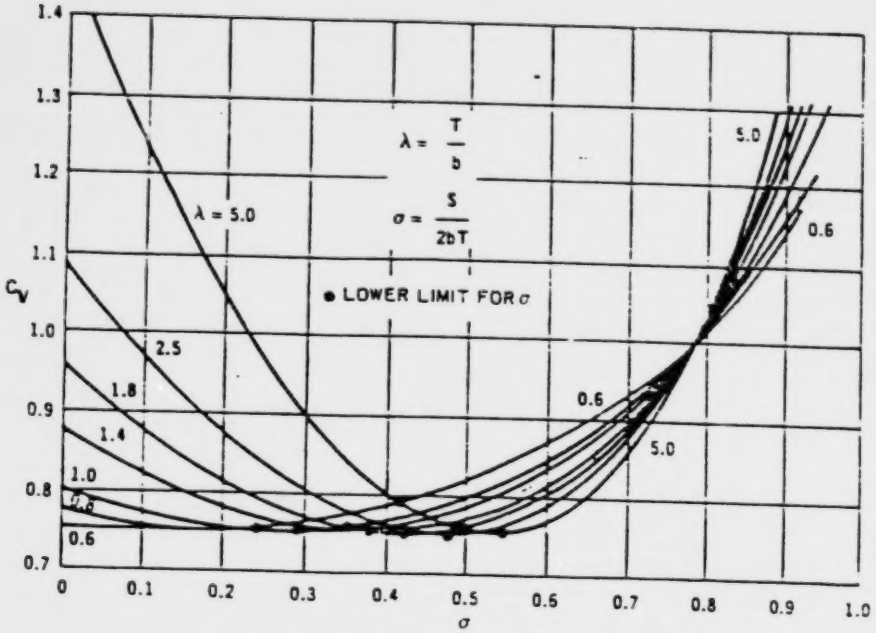


Figure 14 - Virtual Mass Coefficient for Vertical Vibration

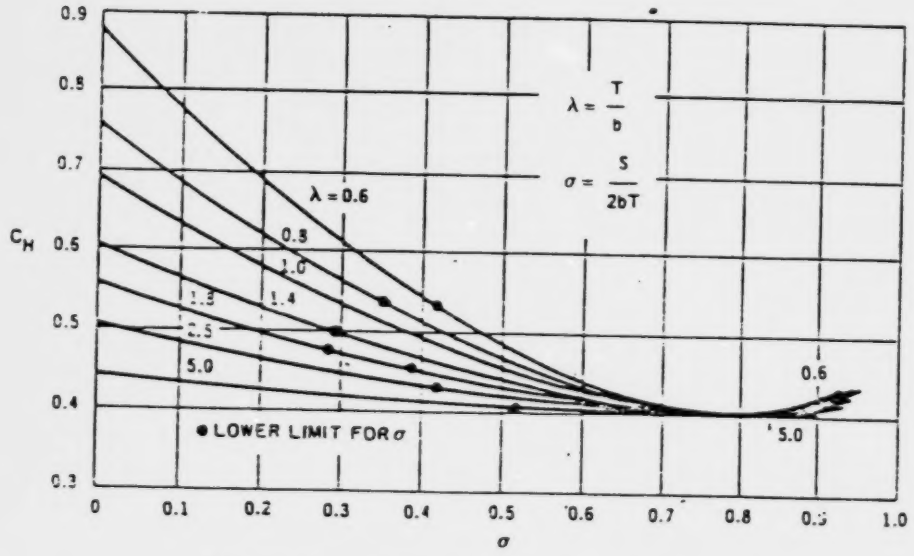


Figure 15 - Virtual Mass Coefficient for Horizontal Vibration

ANNEX 2

EXAMPLES OF GBRP OUTPUT

AND NATURAL FREQUENCY CALCULATIONS

USING EMPIRICAL FORMULA

SECTION 1

EXAMPLES OF GBRP OUTPUT

SAMPLE PROBLEM 1

SIMPLE HARMONIC OSCILLATOR
RESPONSE TO A TRANSIENT RECTANGULAR IMPULSE

```
 ELAPSED TIME AT ENTRY INTO GBRP =     4.358E+00  SECONDS
1 GBRP   NOV. 1974
  SIMPLE HARMONIC OSCILLATOR
0DATA CONTROL CARD

 NO  TYPE

  1   10
  1   20
  1   30
  1   32
  1   41
  1   43
  1   51
  1   53
0CASE TITLE-RESPONSE TO RECTANGULAR FORCING FUNCTION
0OPTION DATA
  20       0   0   0   3   0   0   0   3   0   0
0GENERAL DATA -  NUMBER OF SECTIONS     1
                 FREQUENCY RANGE FROM       .000 CPS  TO    14.950 CPS
                 FREQUENCY INTERVAL     .050 CPS
                 POWER OF FREQUENCY =  0.000


 REAL PARTS OF SCALING FACTORS
0SECTION-END CONDN-SYSTEM    MASS      WATER INERTIA    DX/      DX      DX/KAG    IMZ*DX      P(N)/Y
                                                        EI(N)   (N,N+1)  (N,N+1)   (N,N+1)
                     1    1.0000E+00    0.              0.       0.       0.        0.        0.

 PARAMETER VALUES FOR EACH SECTION - UNSCALED
0SECTION-END CONDN-SYSTEM    MASS      WATER INERTIA    DX/      DX      DX/KAG    IMZ*DX      P(N)/Y
                                                        EI(N)   (N,N+1)  (N,N+1)   (N,N+1)
      1      0       1    1.0000E+00    0.              0.       0.       0.        0.        0.

 REAL PARTS OF SCALING FACTORS
0     N      M     SYSTEM   K(N,M)        C(N,M)        C(N,      DX      DX/KAG    IMZ*DX    Q(N,M)/Y
                                                        (N,M)/W  (N,M)    (N,M)     (N,M)
                     1    1.0000E+00    1.0000E+00      0.       0.       0.        0.        0.

 PARAMETER VALUES FOR SPECIAL CONNECTIONS
0     N      M     SYSTEM   K(N,M)        C(N,M)        C(N,M     DX      DX/KAG    IMZ*DX    Q(N,M)/Y
                                                        (N,M)/W  (N,M)    (N,M)     (N,M)
      1      0       1    8.4000E+00    6.0000E-01      0.       0.       0.        0.        0.
```

SECTION 1

TIME(SECS)	DISPLACEMENT(XY-PLANE)
0.	-5.659229E-05
4.8828E-02	6.246646E-04
9.7656E-02	2.451694E-03
1.4648E-01	5.353963E-03
1.9531E-01	9.238823E-03
2.4414E-01	1.400018E-02
2.9297E-01	1.952172E-02
3.4180E-01	2.567350E-02
3.9063E-01	3.231395E-02
4.3945E-01	3.929775E-02
4.8828E-01	4.647918E-02
5.3711E-01	5.371108E-02
5.8594E-01	6.084792E-02
6.3477E-01	6.775207E-02
6.8359E-01	7.429559E-02
7.3242E-01	8.035946E-02
7.8125E-01	8.583688E-02
8.3008E-01	9.063756E-02
8.7891E-01	9.468740E-02
9.2773E-01	9.792743E-02
9.7656E-01	1.003164E-01
1.0742E+00	1.024727E-01
1.1230E+00	1.022474E-01
1.1719E+00	1.011861E-01
1.2207E+00	9.933508E-02
1.2695E+00	9.675368E-02
1.3184E+00	9.351257E-02
1.3672E+00	8.969484E-02
1.4160E+00	8.539369E-02
1.4648E+00	8.070735E-02
1.5137E+00	7.573793E-02
1.5625E+00	7.059231E-02
1.6113E+00	6.537837E-02
1.6602E+00	6.019959E-02
1.7090E+00	5.515556E-02
1.7578E+00	5.034351E-02
1.8066E+00	4.585319E-02
1.8555E+00	4.176126E-02
1.9043E+00	3.813448E-02
1.9531E+00	3.503400E-02
2.0020E+00	3.250059E-02
2.0508E+00	2.987973E-02
2.0996E+00	2.674078E-02
2.1484E+00	2.316241E-02
2.1973E+00	1.923198E-02
2.2461E+00	1.503790E-02
2.2949E+00	1.066796E-02
2.3438E+00	6.212841E-03
2.3926E+00	1.764539E-03
2.4414E+00	-2.589344E-03
2.4902E+00	-6.767089E-03
2.5391E+00	-1.069137E-02
2.5879E+00	-1.429113E-02
2.6367E+00	-1.750508E-02
2.6855E+00	-2.028184E-02
2.7344E+00	-2.257895E-02
2.7832E+00	-2.436438E-02
2.8320E+00	-2.561817E-02
2.8809E+00	-2.633140E-02
2.9297E+00	-2.650515E-02
2.9785E+00	-2.615128E-02
3.0273E+00	-2.529250E-02
3.0762E+00	-2.396044E-02
3.1250E+00	-2.219454E-02
3.1738E+00	-2.004210E-02
3.2227E+00	-1.755711E-02
3.2715E+00	-1.479809E-02
3.3203E+00	-1.182691E-02
3.3691E+00	-8.708404E-03
3.4180E+00	-5.508579E-03
3.4668E+00	-2.292623E-03
3.5156E+00	8.758773E-04
3.5645E+00	3.935609E-03
3.6133E+00	6.829254E-03
3.6621E+00	9.504869E-03
3.7109E+00	1.191612E-02
3.7598E+00	1.402286E-02
3.8086E+00	1.579233E-02
3.8574E+00	1.719969E-02
3.9063E+00	1.822761E-02
3.9551E+00	1.886655E-02
4.0039E+00	1.911525E-02
4.0527E+00	1.898029E-02
4.1016E+00	1.847525E-02
4.1504E+00	1.762062E-02
4.1992E+00	1.644349E-02
4.2480E+00	1.497649E-02
4.2969E+00	1.325670E-02
4.3457E+00	1.132524E-02
4.3945E+00	9.226480E-03
4.4434E+00	7.006611E-03
4.4922E+00	4.712677E-03
4.5410E+00	2.392051E-03
4.5898E+00	9.140742E-05
4.6387E+00	-2.144579E-03
4.6875E+00	-4.273869E-03
4.7363E+00	-6.257477E-03
4.7852E+00	-8.060405E-03
4.8340E+00	-9.652483E-03

-EOR--

SAMPLE PROBLEM 2

SYSTEM OF SPRINGS AND MASSES
RESPONSE TO A TRANSIENT RECTANGULAR IMPULSE

```
0DIMENSIONS FOR ARRAYS
0 DIMENSION 16 =  100
  DIMENSION 17 =   16
  DIMENSION 18 =  500
  DIMENSION 19 = 1501
OCM REDUCED TO 210700 (OCTAL)

 PERIOD OF FORCING FUNCTION =  3.000E+01 SECONDS

 SAMPLING RATE =  2048 POINTS PER PERIOD

  500 COMPLEX FREQUENCY RESPONSE POINTS USED IN COMPUTING TIME RESPONSE
```

SAMPLED IMPULSE POINTS

5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.
5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.	5.000E-01	0.

```
 ELAPSED TIME AT ENTRY INTO GBRP =     5.128E+00  SECONDS
1 GBRP   NOV. 1974
  MULTI-SECTION SYSTEM
0DATA CONTROL CARD
 NO  TYPE

  1   10
  1   20
  1   30
  1   32
  1   41
  3   43
  1   51
  3   53
0CASE TITLE-RESPONSE TO RECTANGULAR FORCING FUNCTION
0OPTION DATA

FREQUENCY RANGE FROM       .000 CPS  TO    16.633 CPS
FREQUENCY INTERVAL     .033 CPS
POWER OF FREQUENCY =  0.000

 REAL PARTS OF SCALING FACTORS
0SECTION-END CONDN-SYSTEM    MASS      WATER INERTIA    DX/      DX.      DX/KAG    IMZ*DX      P(N)/Y
                                                        EI(N)   (N,N+1)   (N,N+1)   (N,N+1)
                    1    1.0000E+00    0.               0.       0.        0.        0.        0.

 PARAMETER VALUES FOR EACH SECTION - UNSCALED
0SECTION-END CONDN-SYSTEM    MASS      WATER INERTIA    DX/      DX       DX/KAG    IMZ*DX      P(N)/Y
                                                        EI(N)   (N,N+1)   (N,N+1)   (N,N+1)
     1      0       1    1.0000E+00    0.               0.       0.        0.        0.        0.
     2      0       1    1.0000E+00    0.               0.       0.        0.        0.        0.
     3      0       1    2.0000E+00    0.               0.       0.        0.        0.        0.

 REAL PARTS OF SCALING FACTORS
0     N      M     SYSTEM   K(N,M)        C(N,M)        C        DX       DX/KAG    IMZ*DX    Q(N,M)/Y
                                                       (N,M)/W   (N,M)     (N,M)     (N,M)
                    1    1.0000E+00    1.0000E+00       0.       0.        0.        0.        0.

 PARAMETER VALUES FOR SPECIAL CONNECTIONS
0     N      M     SYSTEM   K(N,M)        C(N,M)        C        DX       DX/KAG    IMZ*DX    Q(N,M)/Y
                                                       (N,M)/W   (N,M)     (N,M)     (N,M)
     1      2       1    2.0000E+03    1.0000E+02       0.       0.        0.        0.        0.
     2      3       1    4.0000E+03    2.0000E+02       0.       0.        0.        0.        0.
     3      0       1    6.0000E+03    3.0000E+02       0.       0.        0.        0.        0.
```

SECTION 1

TIME(SECS)	DISPLACEMENT (XY-PLANE)
0.	1.444521E-05
4.3945E-02	2.393745E-04
8.7891E-02	4.139051E-04
1.3184E-01	4.713956E-04
1.7578E-01	4.731195E-04
2.1973E-01	4.635508E-04
2.6367E-01	4.580094E-04
3.0762E-01	4.573936E-04
3.5156E-01	4.581496E-04
3.9551E-01	4.581901E-04
4.3945E-01	4.581237E-04
4.8340E-01	4.584545E-04
5.2734E-01	4.585107E-04
5.7129E-01	4.582107E-04
6.1523E-01	4.582313E-04
6.5918E-01	4.584707E-04
7.0313E-01	4.583741E-04
7.4707E-01	4.581968E-04
7.9102E-01	4.583449E-04
8.3496E-01	4.584538E-04
8.7891E-01	4.582775E-04
9.2285E-01	4.582408E-04
9.6680E-01	4.584235E-04
1.0107E+00	4.583884E-04
1.0547E+00	4.582204E-04
1.0986E+00	4.583227E-04
1.1426E+00	4.584559E-04
1.1865E+00	4.582950E-04
1.2305E+00	4.582157E-04
1.2744E+00	4.584225E-04
1.3184E+00	4.584306E-04
1.3623E+00	4.581942E-04
1.4063E+00	4.582737E-04
1.4502E+00	4.585193E-04
1.4941E+00	4.583364E-04
1.5381E+00	4.581066E-04
1.5820E+00	4.584101E-04
1.6260E+00	4.585928E-04
1.6699E+00	4.581446E-04
1.7139E+00	4.580511E-04
1.7578E+00	4.586904E-04
1.8018E+00	4.586303E-04
1.8457E+00	4.576743E-04
1.8896E+00	4.579967E-04
1.9775E+00	4.598495E-04
2.0215E+00	3.892225E-04
2.0654E+00	1.452643E-04
2.1094E+00	1.312417E-05
2.1533E+00	-1.636540E-05
2.1973E+00	-1.069847E-05
2.2412E+00	-3.230271E-06
2.2852E+00	3.793351E-07
2.3291E+00	1.188432E-06
2.3730E+00	3.760328E-07
2.4170E+00	-2.789837E-07
2.4609E+00	1.146784E-08
2.5049E+00	2.357398E-07
2.5488E+00	-1.092331E-07
2.5928E+00	-2.013854E-07
2.6367E+00	1.396513E-07
2.6807E+00	1.458765E-07
2.7246E+00	-1.582486E-07
2.7686E+00	-9.145364E-08
2.8125E+00	1.657696E-07
2.8564E+00	4.241409E-08
2.9004E+00	-1.619714E-07
2.9443E+00	1.128220E-09
2.9883E+00	1.492633E-07
3.0322E+00	-3.784775E-08
3.0762E+00	-1.292292E-07
3.1201E+00	6.739379E-08
3.1641E+00	1.042321E-07
3.2080E+00	-8.891228E-08
3.2520E+00	-7.581716E-08
3.2959E+00	1.026504E-07
3.3398E+00	4.620758E-08
3.3838E+00	-1.084624E-07
3.4277E+00	-1.679171E-08
3.4717E+00	1.072150E-07
3.5156E+00	-1.054532E-08
3.5596E+00	-9.939708E-08
3.6035E+00	3.479923E-08
3.6475E+00	8.636762E-08
3.6914E+00	-5.461951E-08
3.7354E+00	-6.905422E-08
3.7793E+00	6.955599E-08
3.8232E+00	4.907892E-08
3.8672E+00	-7.890525E-08
3.9111E+00	-2.754215E-08
3.9551E+00	8.283504E-08
3.9990E+00	6.056812E-09
4.0430E+00	-8.128617E-08
4.0869E+00	2.214804E-08
4.1309E+00	2.048267E-08
4.1748E+00	-2.644667E-08
4.2188E+00	-1.322034E-08
4.2627E+00	2.889475E-08
4.3066E+00	5.667799E-09
4.3506E+00	-2.937075E-08

SECTION 2

TIME(SECS)	DISPLACEMENT(XY-PLANE)
0.	2.513022E-07
4.3945E-02	9.990537E-05
8.7891E-02	1.906268E-04
1.3184E-01	2.198905E-04
1.7578E-01	2.184619E-04
2.1973E-01	2.117871E-04
2.6367E-01	2.083809E-04
3.0762E-01	2.079250E-04
3.5156E-01	2.081689E-04
3.9551E-01	2.082028E-04
4.3945E-01	2.082844E-04
4.8340E-01	2.084288E-04
5.2734E-01	2.083741E-04
5.7129E-01	2.082623E-04
6.1523E-01	2.083272E-04
6.5918E-01	2.083959E-04
7.0313E-01	2.083167E-04
7.4707E-01	2.082831E-04
7.9102E-01	2.083659E-04
8.3496E-01	2.083674E-04
8.7891E-01	2.082905E-04
9.2285E-01	2.083176E-04
9.6680E-01	2.083808E-04
1.0107E+00	2.083300E-04
1.0547E+00	2.082870E-04
1.0986E+00	2.083555E-04
1.1426E+00	2.083727E-04
1.1865E+00	2.082939E-04
1.2305E+00	2.083065E-04
1.2744E+00	2.083875E-04
1.3184E+00	2.083422E-04
1.3623E+00	2.082683E-04
1.4063E+00	2.083477E-04
1.4502E+00	2.084044E-04
1.4941E+00	2.082902E-04
1.5381E+00	2.082629E-04
1.5820E+00	2.084115E-04
1.6260E+00	2.083949E-04
1.6699E+00	2.082114E-04
1.7139E+00	2.082926E-04
1.7578E+00	2.085155E-04
1.8018E+00	2.083339E-04
1.8457E+00	2.080476E-04
1.8896E+00	2.084127E-04
1.9336E+00	2.089241E-04
1.9775E+00	2.082281E-04
2.0215E+00	1.860076E-04
2.0654E+00	7.011202E-05
2.1094E+00	1.786365E-06
2.1533E+00	-1.235651E-05
2.1973E+00	-7.580036E-06
2.2412E+00	-2.214697E-06
2.2852E+00	2.449170E-07
2.3291E+00	5.904693E-07
2.3730E+00	1.210961E-07
2.4170E+00	-8.840213E-08
2.4609E+00	5.751568E-08
2.5049E+00	5.629839E-08
2.5488E+00	-9.104731E-08
2.5928E+00	-4.211633E-08
2.6367E+00	8.653022E-08
2.6807E+00	1.713996E-08
2.7246E+00	-8.019194E-08
2.7686E+00	4.673334E-09
2.8125E+00	7.142009E-08
2.8564E+00	-2.180017E-08
2.9004E+00	-5.989145E-08
2.9443E+00	3.482664E-08
2.9883E+00	4.668947E-08
3.0322E+00	-4.372181E-08
3.0762E+00	-3.251441E-08
3.1201E+00	4.884000E-08
3.1641E+00	1.834969E-08
3.2080E+00	-5.027373E-08
3.2520E+00	-4.742998E-09
3.2959E+00	4.856570E-08
3.3398E+00	-7.517214E-09
3.3838E+00	-4.402311E-08
3.4277E+00	1.807722E-08
3.4717E+00	3.734130E-08
3.5156E+00	-2.640532E-08
3.5596E+00	-2.896798E-08
3.6035E+00	3.239909E-08
3.6475E+00	1.966203E-08
3.6914E+00	-3.581474E-08
3.7354E+00	-9.904122E-09
3.7793E+00	3.681315E-08
3.8232E+00	4.078781E-10
3.8672E+00	-3.542194E-08
3.9111E+00	8.423675E-09
3.9551E+00	3.202837E-08
3.9990E+00	-1.602134E-08
4.0430E+00	-2.686983E-08
4.0869E+00	2.214804E-08
4.1309E+00	2.048267E-08
4.1748E+00	-2.644667E-08
4.2188E+00	-1.322034E-08
4.2627E+00	2.889475E-08
4.3066E+00	5.667799E-09
4.3506E+00	-2.937075E-08

SECTION 3

TIME(SECS)	DISPLACEMENT(XY-PLANE)
0.	2.513022E-07
4.3945E-02	3.730859E-05
8.7891E-02	7.689054E-05
1.3184E-01	8.953830E-05
1.7578E-01	8.833481E-05
2.1973E-01	8.501350E-05
2.6367E-01	8.340320E-05
3.0762E-01	8.316238E-05
3.5156E-01	8.323511E-05
3.9551E-01	8.326541E-05
4.3945E-01	8.332922E-05
4.8340E-01	8.337849E-05
5.2734E-01	8.333729E-05
5.7129E-01	8.330440E-05
6.1523E-01	8.334187E-05
6.5918E-01	8.335524E-05
7.0313E-01	8.331808E-05
7.4707E-01	8.331890E-05
7.9102E-01	8.335201E-05
8.3496E-01	8.333975E-05
8.7891E-01	8.331366E-05
9.2285E-01	8.333478E-05
9.6680E-01	8.335170E-05
1.0107E+00	8.332464E-05
1.0547E+00	8.331841E-05
1.0986E+00	8.334824E-05
1.1426E+00	8.334286E-05
1.1865E+00	8.331366E-05
1.2305E+00	8.333091E-05
1.2744E+00	8.335596E-05
1.3184E+00	8.332720E-05
1.3623E+00	8.330999E-05
1.4063E+00	8.334926E-05
1.4502E+00	8.335476E-05
1.4941E+00	8.330657E-05
1.5381E+00	8.331708E-05
1.5820E+00	8.337205E-05
1.6260E+00	8.334031E-05
1.6699E+00	8.328113E-05
1.7139E+00	8.334168E-05
1.7578E+00	8.340253E-05
1.8018E+00	8.329904E-05
1.8457E+00	8.323629E-05
1.8896E+00	8.341972E-05
1.9336E+00	8.351756E-05
1.9775E+00	8.311570E-05
2.0215E+00	7.665966E-05
2.0654E+00	2.940515E-05
2.1094E+00	-4.102988E-07
2.1533E+00	-6.353350E-06
2.1973E+00	-3.795476E-06
2.2412E+00	-1.073177E-06
2.2852E+00	1.265910E-07
2.3291E+00	2.499805E-07
2.3730E+00	4.233542E-08
2.4170E+00	-1.833180E-08
2.4609E+00	3.303846E-08
2.5049E+00	5.252292E-09
2.5488E+00	-4.301558E-08
2.5928E+00	-1.489249E-09
2.6367E+00	3.640389E-08
2.7686E+00	1.391916E-08
2.8125E+00	2.389081E-08
2.8564E+00	-1.851859E-08
2.9004E+00	-1.726677E-08
2.9443E+00	2.126863E-08
2.9883E+00	1.069332E-08
3.0322E+00	-2.230171E-08
3.0762E+00	-4.400205E-09
3.1201E+00	2.188627E-08
3.1641E+00	-1.284397E-09
3.2080E+00	-2.017209E-08
3.2520E+00	6.219439E-09
3.2959E+00	1.747067E-08
3,3398E+00	-1.018033E-08
3.3838E+00	-1.397960E-08
3.4277E+00	1.312502E-08
3.4717E+00	1.002888E-08
3.5156E+00	-1.494634E-08
3.5596E+00	-5.826878E-09
3.6035E+00	1.570947E-08
3.6475E+00	1.682858E-09
3.6914E+00	-1.542016E-08
3.7354E+00	2.226657E-09
3.7793E+00	1.423793E-08
3.8232E+00	-5.652236E-09
3.8672E+00	-1.225779E-08
3.9111E+00	8.485209E-09
3.9551E+00	9.703404E-09
3.9990E+00	-1.056408E-08
4.0430E+00	-6.721529E-09
4.0869E+00	1.186906E-08
4.1309E+00	3.559384E-09
4.1748E+00	-1.233742E-08
4.2188E+00	-3.719980E-10
4.2627E+00	1.204041E-08
4.3066E+00	-2.612142E-09
4.3506E+00	-1.100603E-08

--EOR--

SAMPLE PROBLEM 3

20-SECTION UNIFORM FREE/FREE BEAM
NATURAL FREQUENCIES AND MODE SHAPES CALCULATION
IN LONGITUDINAL MODE OF VIBRATION

```
1THERE ARE 122761(OCTAL) WORDS OF OPEN-CORE AVAILABLE FOR THIS PROBLEM


 ELAPSED TIME AT ENTRY INTO GBRP =    4.210E-01  SECONDS
1 GBRP   NOV. 1974
   NAT. FREQ. OF UNIFORM BEAM
0DATA CONTROL CARD

 NO  TYPE

  1   10
  1   20
  1   30
  1   41
 20   43
  1   51
 19   53
  1   70
0CASE TITLE- NATURAL FREQUENCIES
0OPTION DATA
  20       0   0   0   0   0   0   0   0   0   1
0GENERAL DATA -  NUMBER OF SECTIONS  20
                 FREQUENCY RANGE FROM      .000 CPS  TO  2000.000 CPS
                 FREQUENCY INTERVAL    .500 CPS
                 POWER OF FREQUENCY =  0.000
```

REAL PARTS OF SCALING FACTORS

OSECTION-END	CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX (N,N+1)	DX/KAG (N,N+1)	IMZ*DX (N,N+1)	P(N)/Y
	1	1.0000E+00	0.	0.	0.	0.	0.	0.

PARAMETER VALUES FOR EACH SECTION - UNSCALED

OSECTION-END	CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX (N,N+1)	DX/KAG (N,N+1)	IMZ*DX (N,N+1)	P(N)/Y
1	1 1	1.8932E+01	0.	0.	0.	0.	0.	0.
2	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
3	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
4	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
5	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
6	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
7	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
8	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
9	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
10	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
11	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
12	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
13	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
14	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
15	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
16	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
17	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
18	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
19	0 1	1.8932E+01	0.	0.	0.	0.	0.	0.
20	1 1	1.8932E+01	0.	0.	0.	0.	0.	0.

O N	M	SYSTEM	K(N,M)	C(N,M)	C (N,M)/W	DX (N,M)	DX/KAG (N,M)	IMZ*DX (N,M)	Q(N,M)/Y
		1	1.0000E+06	0.	0.	0.	0.	0.	0.

PARAMETER VALUES FOR SPECIAL CONNECTIONS

O N	M	SYSTEM	K(N,M)	C(N,M)	C (N,M)/W	DX (N,M)	DX/KAG (N,M)	IMZ*DX (N,M)	Q(N,M)/Y
1	2	1	1.4256E+00	0.	0.	0.	0.	0.	0.
2	3	1	1.4256E+00	0.	0.	0.	0.	0.	0.
3	4	1	1.4256E+00	0.	0.	0.	0.	0.	0.
4	5	1	1.4256E+00	0.	0.	0.	0.	0.	0.
5	6	1	1.4256E+00	0.	0.	0.	0.	0.	0.
6	7	1	1.4256E+00	0.	0.	0.	0.	0.	0.
7	8	1	1.4256E+00	0.	0.	0.	0.	0.	0.
8	9	1	1.4256E+00	0.	0.	0.	0.	0.	0.
9	10	1	1.4256E+00	0.	0.	0.	0.	0.	0.
10	11	1	1.4256E+00	0.	0.	0.	0.	0.	0.
11	12	1	1.4256E+00	0.	0.	0.	0.	0.	0.
12	13	1	1.4256E+00	0.	0.	0.	0.	0.	0.
13	14	1	1.4256E+00	0.	0.	0.	0.	0.	0.
14	15	1	1.4256E+00	0.	0.	0.	0.	0.	0.
15	16	1	1.4256E+00	0.	0.	0.	0.	0.	0.
16	17	1	1.4256E+00	0.	0.	0.	0.	0.	0.
17	18	1	1.4256E+00	0.	0.	0.	0.	0.	0.
18	19	1	1.4256E+00	0.	0.	0.	0.	0.	0.
19	20	1	1.4256E+00	0.	0.	0.	0.	0.	0.

O THE NUMBER OF NATURAL FREQUENCIES REQUESTED IS 5
OTHE MINIMUM AMOUNT OF OPEN CORE NEEDED FOR THE STEADY-STATE PORTION OF THIS PROBLEM IS 003606(OCTAL) WORDS
ODIMENSIONS FOR ARRAYS
O DIMENSION 1 = 40
DIMENSION 2 = 20
DIMENSION 3 = 57
DIMENSION 4 = 4
DIMENSION 5 = 5
DIMENSION 6 = 0
DIMENSION 7 = 0
DIMENSION 8 = 0
DIMENSION 9 = 0
DIMENSION 10 = 0
DIMENSION 11 = 0
DIMENSION 12 = 0
DIMENSION 13 = 0
DIMENSION 14 = 1
DIMENSION 15 = 1

CM REDUCED TO 060700 (OCTAL)
0 THE NUMBER OF NATURAL FREQUENCIES FOUND IS 5
1 GBRP

NAT. FREQ. OF UNIFORM BEAM

NATURAL FREQUENCIES

FREQUENCY 6.85 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	9.7538E-01	0.	9.7538E-01	0.	0.	0.	0.	0.
3	9.2674E-01	0.	9.2674E-01	0.	0.	0.	0.	0.
4	8.5528E-01	0.	8.5528E-01	0.	0.	0.	0.	0.
5	7.6276E-01	0.	7.6276E-01	0.	0.	0.	0.	0.
6	6.5146E-01	0.	6.5146E-01	0.	0.	0.	0.	0.
7	5.2411E-01	0.	5.2411E-01	0.	0.	0.	0.	0.
8	3.8387E-01	0.	3.8387E-01	0.	0.	0.	0.	0.
9	2.3417E-01	0.	2.3417E-01	0.	0.	0.	0.	0.
10	7.8702E-02	0.	7.8702E-02	0.	0.	0.	0.	0.
11	-7.8702E-02	0.	7.8702E-02	0.	0.	0.	0.	0.
12	-2.3417E-01	0.	2.3417E-01	0.	0.	0.	0.	0.
13	-3.8387E-01	0.	3.8387E-01	0.	0.	0.	0.	0.
14	-5.2411E-01	0.	5.2411E-01	0.	0.	0.	0.	0.
15	-6.5146E-01	0.	6.5146E-01	0.	0.	0.	0.	0.
16	-7.6276E-01	0.	7.6276E-01	0.	0.	0.	0.	0.
17	-8.5528E-01	0.	8.5528E-01	0.	0.	0.	0.	0.
18	-9.2674E-01	0.	9.2674E-01	0.	0.	0.	0.	0.
19	-9.7538E-01	0.	9.7538E-01	0.	0.	0.	0.	0.
20	-1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.

1 GBRP

NAT. FREQ. OF UNIFORM BEAM

NATURAL FREQUENCIES

FREQUENCY 13.66 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	9.0209E-01	0.	9.0209E-01	0.	0.	0.	0.	0.
3	7.1587E-01	0.	7.1587E-01	0.	0.	0.	0.	0.
4	4.5958E-01	0.	4.5958E-01	0.	0.	0.	0.	0.
5	1.5831E-01	0.	1.5831E-01	0.	0.	0.	0.	0.
6	-1.5847E-01	0.	1.5847E-01	0.	0.	0.	0.	0.
7	-4.5973E-01	0.	4.5973E-01	0.	0.	0.	0.	0.
8	-7.1599E-01	0.	7.1599E-01	0.	0.	0.	0.	0.
9	-9.0216E-01	0.	9.0216E-01	0.	0.	0.	0.	0.
10	-1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
11	-1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
12	-9.0211E-01	0.	9.0211E-01	0.	0.	0.	0.	0.
13	-7.1592E-01	0.	7.1592E-01	0.	0.	0.	0.	0.
14	-4.5965E-01	0.	4.5965E-01	0.	0.	0.	0.	0.
15	-1.5838E-01	0.	1.5838E-01	0.	0.	0.	0.	0.
16	1.5838E-01	0.	1.5838E-01	0.	0.	0.	0.	0.
17	4.5965E-01	0.	4.5965E-01	0.	0.	0.	0.	0.
18	7.1592E-01	0.	7.1592E-01	0.	0.	0.	0.	0.
19	9.0211E-01	0.	9.0211E-01	0.	0.	0.	0.	0.
20	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.

1 GBRF

NAT. FREQ. OF UNIFORM BEAM

NATURAL FREQUENCIES

NATURAL FREQUENCIES

FREQUENCY 20.39 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	7.8201E-01	0.	7.8201E-01	0.	0.	0.	0.	0.
3	3.9356E-01	0.	3.9356E-01	0.	0.	0.	0.	0.
4	-8.0689E-02	0.	8.0689E-02	0.	0.	0.	0.	0.
5	-5.3735E-01	0.	5.3735E-01	0.	0.	0.	0.	0.
6	-8.7687E-01	0.	8.7687E-01	0.	0.	0.	0.	0.
7	-1.0252E+00	0.	1.0252E+00	0.	0.	0.	0.	0.
8	-9.5013E-01	0.	9.5013E-01	0.	0.	0.	0.	0.
9	-6.6790E-01	0.	6.6790E-01	0.	0.	0.	0.	0.
10	-2.4008E-01	0.	2.4008E-01	0.	0.	0.	0.	0.
11	2.4008E-01	0.	2.4008E-01	0.	0.	0.	0.	0.
12	6.6790E-01	0.	6.6790E-01	0.	0.	0.	0.	0.
13	9.5013E-01	0.	9.5013E-01	0.	0.	0.	0.	0.
14	1.0252E+00	0.	1.0252E+00	0.	0.	0.	0.	0.
15	8.7687E-01	0.	8.7687E-01	0.	0.	0.	0.	0.
16	5.3735E-01	0.	5.3735E-01	0.	0.	0.	0.	0.
17	8.0689E-02	0.	8.0689E-02	0.	0.	0.	0.	0.
18	-3.9356E-01	0.	3.9356E-01	0.	0.	0.	0.	0.
19	-7.8201E-01	0.	7.8201E-01	0.	0.	0.	0.	0.
20	-1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.

1 GBRP

NAT. FREQ. OF UNIFORM BEAM

NATURAL FREQUENCIES

FREQUENCY 26.99 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	6.1793E-01	0.	6.1793E-01	0.	0.	0.	0.	0.
3	-1.6272E-04	0.	1.6272E-04	0.	0.	0.	0.	0.
4	-6.1820E-01	0.	6.1820E-01	0.	0.	0.	0.	0.
5	-1.0001E+00	0.	1.0001E+00	0.	0.	0.	0.	0.
6	-1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
7	-6.1801E-01	0.	6.1801E-01	0.	0.	0.	0.	0.
8	4.6478E-05	0.	4.6478E-05	0.	0.	0.	0.	0.
9	6.1808E-01	0.	6.1808E-01	0.	0.	0.	0.	0.
10	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
11	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
12	6.1802E-01	0.	6.1802E-01	0.	0.	0.	0.	0.
13	-2.2433E-05	0.	2.2433E-05	0.	0.	0.	0.	0.
14	-6.1806E-01	0.	6.1806E-01	0.	0.	0.	0.	0.
15	-1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
16	-1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
17	-6.1803E-01	0.	6.1803E-01	0.	0.	0.	0.	0.
18	-7.4784E-11	0.	7.4784E-11	0.	0.	0.	0.	0.
19	6.1803E-01	0.	6.1803E-01	0.	0.	0.	0.	0.
20	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.

1 GBRP

NAT. FREQ. OF UNIFORM BEAM

NATURAL FREQUENCIES

NATURAL FREQUENCIES

FREQUENCY 33.43 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	4.1451E-01	0.	4.1451E-01	0.	0.	0.	0.	0.
3	-4.1379E-01	0.	4.1379E-01	0.	0.	0.	0.	0.
4	-9.9970E-01	0.	9.9970E-01	0.	0.	0.	0.	0.
5	-1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
6	-4.1445E-01	0.	4.1445E-01	0.	0.	0.	0.	0.
7	4.1388E-01	0.	4.1388E-01	0.	0.	0.	0.	0.
8	9.9976E-01	0.	9.9976E-01	0.	0.	0.	0.	0.
9	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
10	4.1435E-01	0.	4.1435E-01	0.	0.	0.	0.	0.
11	-4.1402E-01	0.	4.1402E-01	0.	0.	0.	0.	0.
12	-9.9986E-01	0.	9.9986E-01	0.	0.	0.	0.	0.
13	-1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
14	-4.1424E-01	0.	4.1424E-01	0.	0.	0.	0.	0.
15	4.1418E-01	0.	4.1418E-01	0.	0.	0.	0.	0.
16	9.9998E-01	0.	9.9998E-01	0.	0.	0.	0.	0.
17	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
18	4.1421E-01	0.	4.1421E-01	0.	0.	0.	0.	0.
19	-4.1421E-01	0.	4.1421E-01	0.	0.	0.	0.	0.
20	-1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.

SAMPLE PROBLEM 4

20-SECTION UNIFORM FIXED/FREE BEAM
NATURAL FREQUENCIES AND MODE SHAPE CALCULATION
IN LONGITUDINAL MODE OF VIBRATION

```
NO  TYPE
                    NAT. FREQ. OF UNIFORM BEAM
                  0DATA CONTROL CARD
 1   10
 1   20
 1   30
 1   41
20   43
 1   51
20   53
 1   70
0CASE TITLE- NATURAL FREQUENCIES
0OPTION DATA
 20       0   0   0   0   0   0   0   0   0   1
0GENERAL DATA -  NUMBER OF SECTIONS   20
                 FREQUENCY RANGE FROM       .000 CPS  TO  2000.000 CPS
                 FREQUENCY INTERVAL     .500 CPS
                 POWER OF FREQUENCY =  0.000
 REAL PARTS OF SCALING FACTORS
0SECTION-END CONDN-SYSTEM    MASS      WATER INERTIA    DX/EI    DX       DX/KAG    IMZ*DX      P(N
                                                        (N)     (N,N+1)   (N,N+1)   (N,N+1)     /Y
                     1    1.0000E+00    0.             0.       0.        0.        0.        0.
 PARAMETER VALUES FOR EACH SECTION - UNSCALED
0SECTION-END CONDN-SYSTEM    MASS      WATER INERTIA    DX/EI    DX       DX/KAG    IMZ*DX      P(N
                                                        (N)     (N,N+1)   (N,N+1)   (N,N+1)     /Y
      1       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
      2       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
      3       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
      4       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
      5       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
      6       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
      7       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
      8       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
      9       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
     10       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
     11       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
     12       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
     13       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
     14       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
     15       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
     16       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
     17       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
     18       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
     19       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
     20       0       1    1.8932E+01    0.             0.       0.        0.        0.        0.
```

```
0 DIMENSION  1 =  40
  DIMENSION  2 =  20
  DIMENSION  3 =  57
  DIMENSION  4 =   4
  DIMENSION  5 =   5
  DIMENSION  6 =   0
  DIMENSION  7 =   0
  DIMENSION  8 =   0
  DIMENSION  9 =   0
  DIMENSION 10 =   0
  DIMENSION 11 =   0
  DIMENSION 12 =   0
  DIMENSION 13 =   0
  DIMENSION 14 =   1
  DIMENSION 15 =   1
  REAL PARTS OF SCALING FACTORS
```

0 N	M	SYSTEM	K(N,M)	C(N,M)	C (N,M)/W	DX (N,M)	DX/KAG (N,M)	IMZ*DX (N,M)	Q(N,M)/Y
		1	1.0000E+06	1.0000E+00	0.	0.	0.	0.	0.

PARAMETER VALUES FOR SPECIAL CONNECTIONS

0 N	M	SYSTEM	K(N,M)	C(N,M)	C (N,M)/W	DX (N,M)	DX/KAG (N,M)	IMZ*DX (N,M)	Q(N,M)/Y
1	2	1	1.4256E+00	0.	0.	0.	0.	0.	0.
2	3	1	1.4256E+00	0.	0.	0.	0.	0.	0.
3	4	1	1.4256E+00	0.	0.	0.	0.	0.	0.
4	5	1	1.4256E+00	0.	0.	0.	0.	0.	0.
5	6	1	1.4256E+00	0.	0.	0.	0.	0.	0.
6	7	1	1.4256E+00	0.	0.	0.	0.	0.	0.
7	8	1	1.4256E+00	0.	0.	0.	0.	0.	0.
8	9	1	1.4256E+00	0.	0.	0.	0.	0.	0.
9	10	1	1.4256E+00	0.	0.	0.	0.	0.	0.
10	11	1	1.4256E+00	0.	0.	0.	0.	0.	0.
11	12	1	1.4256E+00	0.	0.	0.	0.	0.	0.
12	13	1	1.4256E+00	0.	0.	0.	0.	0.	0.
13	14	1	1.4256E+00	0.	0.	0.	0.	0.	0.
14	15	1	1.4256E+00	0.	0.	0.	0.	0.	0.
15	16	1	1.4256E+00	0.	0.	0.	0.	0.	0.
16	17	1	1.4256E+00	0.	0.	0.	0.	0.	0.
17	18	1	1.4256E+00	0.	0.	0.	0.	0.	0.
18	19	1	1.4256E+00	0.	0.	0.	0.	0.	0.
19	20	1	1.4256E+00	0.	0.	0.	0.	0.	0.
20	0	1	5.0000E+02	5.0000E+03	0.	0.	0.	0.	0.

```
THE NUMBER OF NATURAL FREQUENCIES REQUESTED IS 5
THE MINIMUM AMOUNT OF OPEN CORE NEEDED FOR THE STEADY-STATE PORTION OF THIS PROBLEM IS 007606(OCTAL)
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CM REDUCED TO 060700 (OCTAL)
0 THE NUMBER OF NATURAL FREQUENCIES FOUND IS 5
1 GBRP

NAT. FREQ. OF UNIFORM BEAM

NATURAL FREQUENCIES

FREQUENCY 3.52 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	9.9353E-01	-4.0863E-09	9.9353E-01	-2.3565E-07	0.	0.	0.	0.
3	9.8062E-01	-8.1461E-09	9.8062E-01	-4.7596E-07	0.	0.	0.	0.
4	9.6135E-01	-1.2153E-08	9.6135E-01	-7.2431E-07	0.	0.	0.	0.
5	9.3585E-01	-1.6081E-08	9.3585E-01	-9.8455E-07	0.	0.	0.	0.
6	9.0427E-01	-1.9905E-08	9.0427E-01	-1.2612E-06	0.	0.	0.	0.
7	8.6684E-01	-2.3600E-08	8.6684E-01	-1.5599E-06	0.	0.	0.	0.
8	8.2377E-01	-2.7142E-08	8.2377E-01	-1.8878E-06	0.	0.	0.	0.
9	7.7537E-01	-3.0507E-08	7.7537E-01	-2.2543E-06	0.	0.	0.	0.
10	7.2194E-01	-3.3675E-08	7.2194E-01	-2.6726E-06	0.	0.	0.	0.
11	6.6383E-01	-3.6625E-08	6.6383E-01	-3.1611E-06	0.	0.	0.	0.
12	6.0141E-01	-3.9337E-08	6.0141E-01	-3.7476E-06	0.	0.	0.	0.
13	5.3509E-01	-4.1793E-08	5.3509E-01	-4.4751E-06	0.	0.	0.	0.
14	4.6530E-01	-4.3979E-08	4.6530E-01	-5.4155E-06	0.	0.	0.	0.
15	3.9249E-01	-4.5880E-08	3.9249E-01	-6.6975E-06	0.	0.	0.	0.
16	3.1714E-01	-4.7483E-08	3.1714E-01	-8.5784E-06	0.	0.	0.	0.
17	2.3973E-01	-4.8778E-08	2.3973E-01	-1.1658E-05	0.	0.	0.	0.
18	1.6077E-01	-4.9756E-08	1.6077E-01	-1.7733E-05	0.	0.	0.	0.
19	8.0760E-02	-5.0412E-08	8.0760E-02	-3.5766E-05	0.	0.	0.	0.
20	2.2961E-04	-5.0742E-08	2.2961E-04	-1.2662E-02	0.	0.	0.	0.

1 GBRP

NAT. FREQ. OF UNIFORM BEAM

NATURAL FREQUENCIES

NATURAL FREQUENCIES

FREQUENCY 10.53 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	9.4204E-01	-1.0962E-07	9.4204E-01	-6.6670E-06	0.	0.	0.	0.
3	8.2934E-01	-2.1286E-07	8.2934E-01	-1.4706E-05	0.	0.	0.	0.
4	6.6843E-01	-3.0374E-07	6.6843E-01	-2.6035E-05	0.	0.	0.	0.
5	4.6868E-01	-3.7696E-07	4.6868E-01	-4.6083E-05	0.	0.	0.	0.
6	2.4169E-01	-4.2828E-07	2.4169E-01	-1.0153E-04	0.	0.	0.	0.
7	6.5608E-04	-4.5470E-07	6.5608E-04	-3.9710E-02	0.	0.	0.	0.
8	-2.4042E-01	-4.5470E-07	2.4042E-01	-1.8000E+02	0.	0.	0.	0.
9	-4.6752E-01	-4.2828E-07	4.6752E-01	-1.8000E+02	0.	0.	0.	0.
10	-6.6745E-01	-3.7696E-07	6.6745E-01	-1.8000E+02	0.	0.	0.	0.
11	-8.2859E-01	-3.0374E-07	8.2859E-01	-1.8000E+02	0.	0.	0.	0.
12	-9.4158E-01	-2.1286E-07	9.4158E-01	-1.8000E+02	0.	0.	0.	0.
13	-9.9984E-01	-1.0962E-07	9.9984E-01	-1.8000E+02	0.	0.	0.	0.
14	-1.0000E+00	4.3633E-17	1.0000E+00	1.8000E+02	0.	0.	0.	0.
15	-9.4205E-01	1.0962E-07	9.4205E-01	1.8000E+02	0.	0.	0.	0.
16	-8.2935E-01	2.1286E-07	8.2935E-01	1.8000E+02	0.	0.	0.	0.
17	-6.6845E-01	3.0374E-07	6.6845E-01	1.8000E+02	0.	0.	0.	0.
18	-4.6871E-01	3.7696E-07	4.6871E-01	1.8000E+02	0.	0.	0.	0.
19	-2.4172E-01	4.2828E-07	2.4172E-01	1.8000E+02	0.	0.	0.	0.
20	-6.8735E-04	4.5470E-07	6.8735E-04	1.7996E+02	0.	0.	0.	0.

1 GBRP

NAT. FREQ. OF UNIFORM BEAM

NATURAL FREQUENCIES

FREQUENCY 17.47 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	8.4042E-01	-5.0093E-07	8.4042E-01	-3.4151E-05	0.	0.	0.	0.
3	5.4633E-01	-9.2169E-07	5.4633E-01	-9.6651E-05	0.	0.	0.	0.
4	1.6481E-01	-1.1949E-06	1.6481E-01	-4.1542E-04	0.	0.	0.	0.
5	-2.4309E-01	-1.2769E-06	2.4309E-01	-1.8000E+02	0.	0.	0.	0.
6	-6.1208E-01	-1.1546E-06	6.1208E-01	-1.8000E+02	0.	0.	0.	0.
7	-8.8312E-01	-8.4746E-07	8.8312E-01	-1.8000E+02	0.	0.	0.	0.
8	-1.0128E+00	-4.0470E-07	1.0128E+00	-1.8000E+02	0.	0.	0.	0.
9	-9.8042E-01	1.0284E-07	9.8042E-01	1.8000E+02	0.	0.	0.	0.
10	-7.9112E-01	5.9391E-07	7.9112E-01	1.8000E+02	0.	0.	0.	0.
11	-4.7521E-01	9.8993E-07	4.7521E-01	1.8000E+02	0.	0.	0.	0.
12	-8.3244E-02	1.2275E-06	8.3244E-02	1.8000E+02	0.	0.	0.	0.
13	3.2204E-01	1.2687E-06	3.2204E-01	2.2571E-04	0.	0.	0.	0.
14	6.7579E-01	1.1068E-06	6.7579E-01	9.3835E-05	0.	0.	0.	0.
15	9.2139E-01	7.6774E-07	9.2139E-01	4.7741E-05	0.	0.	0.	0.
16	1.0195E+00	3.0584E-07	1.0195E+00	1.7188E-05	0.	0.	0.	0.
17	9.5449E-01	-2.0500E-07	9.5449E-01	-1.2306E-05	0.	0.	0.	0.
18	7.3670E-01	-6.8304E-07	7.3670E-01	-5.3122E-05	0.	0.	0.	0.
19	4.0101E-01	-1.0518E-06	4.0101E-01	-1.5027E-04	0.	0.	0.	0.
20	1.1406E-03	-1.2522E-06	1.1406E-03	-6.2898E-02	0.	0.	0.	0.

1 GBRP

NAT. FREQ. OF UNIFORM BEAM

NATURAL FREQUENCIES

NATURAL FREQUENCIES

FREQUENCY 24.30 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	6.9126E-01	-1.3479E-06	6.9126E-01	-1.1172E-04	0.	0.	0.	0.
3	1.6850E-01	-2.2785E-06	1.6850E-01	-7.7479E-04	0.	0.	0.	0.
4	-4.0644E-01	-2.5036E-06	4.0644E-01	-1.8000E+02	0.	0.	0.	0.
5	-8.5553E-01	-1.9536E-06	8.5553E-01	-1.8000E+02	0.	0.	0.	0.
6	-1.0397E+00	-7.9865E-07	1.0397E+00	-1.8000E+02	0.	0.	0.	0.
7	-9.0202E-01	6.0356E-07	9.0202E-01	1.8000E+02	0.	0.	0.	0.
8	-4.8502E-01	1.8189E-06	4.8502E-01	1.8000E+02	0.	0.	0.	0.
9	8.2156E-02	2.4711E-06	8.2156E-02	1.7233E-03	0.	0.	0.	0.
10	6.2389E-01	2.3581E-06	6.2389E-01	2.1656E-04	0.	0.	0.	0.
11	9.7246E-01	1.5151E-06	9.7246E-01	8.9267E-05	0.	0.	0.	0.
12	1.0199E+00	2.0294E-07	1.0199E+00	1.1400E-05	0.	0.	0.	0.
13	7.5161E-01	-1.1720E-06	7.5161E-01	-8.9345E-05	0.	0.	0.	0.
14	2.5058E-01	-2.1841E-06	2.5058E-01	-4.9940E-04	0.	0.	0.	0.
15	-3.2803E-01	-2.5200E-06	3.2803E-01	-1.8000E+02	0.	0.	0.	0.
16	-8.0509E-01	-2.0756E-06	8.0509E-01	-1.8000E+02	0.	0.	0.	0.
17	-1.0329E+00	-9.8855E-07	1.0329E+00	-1.8000E+02	0.	0.	0.	0.
18	-9.4085E-01	4.0456E-07	9.4085E-01	1.8000E+02	0.	0.	0.	0.
19	-5.5753E-01	1.6724E-06	5.5753E-01	1.8000E+02	0.	0.	0.	0.
20	-1.5865E-03	2.4225E-06	1.5865E-03	1.7991E+02	0.	0.	0.	0.

1 GBRP

NAT. FREQ. OF UNIFORM BEAM

NATURAL FREQUENCIES

NATURAL FREQUENCIES

FREQUENCY 30.97 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	4.9846E-01	-2.7909E-06	4.9846E-01	-3.2080E-04	0.	0.	0.	0.
3	-2.5379E-01	-4.1781E-06	2.5379E-01	-1.8000E+02	0.	0.	0.	0.
4	-8.7839E-01	-3.4638E-06	8.7839E-01	-1.8000E+02	0.	0.	0.	0.
5	-1.0612E+00	-1.0072E-06	1.0612E+00	-1.8000E+02	0.	0.	0.	0.
6	-7.1022E-01	1.9559E-06	7.1022E-01	1.8000E+02	0.	0.	0.	0.
7	-2.0338E-03	3.9353E-06	2.0338E-03	1.7989E+02	0.	0.	0.	0.
8	7.0718E-01	3.9353E-06	7.0718E-01	3.1884E-04	0.	0.	0.	0.
9	1.0607E+00	1.9559E-06	1.0607E+00	1.0565E-04	0.	0.	0.	0.
10	8.8070E-01	-1.0072E-06	8.8070E-01	-6.5527E-05	0.	0.	0.	0.
11	2.5774E-01	-3.4638E-06	2.5774E-01	-7.7000E-04	0.	0.	0.	0.
12	-4.9486E-01	-4.1781E-06	4.9486E-01	-1.8000E+02	0.	0.	0.	0.
13	-9.9856E-01	-2.7909E-06	9.9856E-01	-1.8000E+02	0.	0.	0.	0.
14	-1.0000E+00	-2.2905E-15	1.0000E+00	-1.8000E+02	0.	0.	0.	0.
15	-4.9846E-01	2.7909E-06	4.9846E-01	1.8000E+02	0.	0.	0.	0.
16	2.5380E-01	4.1781E-06	2.5380E-01	9.4321E-04	0.	0.	0.	0.
17	8.7840E-01	3.4638E-06	8.7840E-01	2.2593E-04	0.	0.	0.	0.
18	1.0612E+00	1.0072E-06	1.0612E+00	5.4383E-05	0.	0.	0.	0.
19	7.1021E-01	-1.9559E-06	7.1021E-01	-1.5779E-04	0.	0.	0.	0.
20	2.0221E-03	-3.9353E-06	2.0221E-03	-1.1151E-01	0.	0.	0.	0.

USCGC POLAR SEA

20-SECTION NON-UNIFORM BEAM SYSTEM

NATURAL FREQUENCIES AND MODE SHAPES CALCULATION
IN HORIZONTAL MODE OF VIBRATION

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OCASE TITLE-NATURAL FREQUENCIES OF HORIZONTAL VIBRATION(USCGC POLAR SEA)
OOPTION DATA
  20        0   0   0   0   0   0   0   0   0   1
OOPTION DATA
  21        1   6  10  15  20   0   0   0   0   0
OGENERAL DATA -  NUMBER OF SECTIONS   20
                 FREQUENCY RANGE FROM       .000 CPS  TO   200.000 CPS
                 FREQUENCY INTERVAL     .050 CPS
                 POWER OF FREQUENCY =  0.000
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REAL PARTS OF SCALING FACTORS

OSECTION-END	CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX (N,N+1)	P(N)/Y
	1	1.0000E+00	0.	1.0000E-10	1.0000E+00	1.0000E-06	0.	0.

PARAMETER VALUES FOR EACH SECTION - UNSCALED

OSECTION-END	CONDN	SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX (N,N+1)	P(N)/Y
1	1	1	1.3775E+01	0.	1.5756E+01	1.7600E+01	6.4143E+00	0.	0.
2	0	1	1.7517E+01	0.	8.9610E+00	1.7600E+01	4.0186E+00	0.	0.
3	0	1	2.1727E+01	0.	7.6241E+00	1.7600E+01	2.9413E+00	0.	0.
4	0	1	2.4786E+01	0.	7.0028E+00	1.7600E+01	2.3489E+00	0.	0.
5	0	1	1.8644E+01	0.	6.6343E+00	1.7600E+01	1.9280E+00	0.	0.
6	0	1	3.4596E+01	0.	6.2402E+00	1.7600E+01	2.1519E+00	0.	0.
7	0	1	3.1560E+01	0.	5.7470E+00	1.7600E+01	2.3163E+00	0.	0
8	0	1	2.7909E+01	0.	5.0815E+00	1.7600E+01	2.2236E+00	0.	0.
9	0	1	2.7543E+01	0.	4.8111E+00	1.7600E+01	2.0717E+00	0.	0.
10	0	1	2.6295E+01	0.	4.2875E+00	1.7600E+01	2.0463E+00	0.	0.
11	0	1	2.6116E+01	0.	3.6714E+00	1.7600E+01	1.7694E+00	0.	0.
12	0	1	2.6268E+01	0.	3.0546E+00	1.7600E+01	1.8226E+00	0.	0.
13	0	1	2.5853E+01	0.	3.0845E+00	1.7600E+01	1.8738E+00	0.	0
14	0	1	2.5691E+01	0.	3.5810E+00	1.7600E+01	1.6846E+00	0.	0
15	0	1	2.5783E+01	0.	4.4489E+00	1.7600E+01	1.3504E+00	0.	0
16	0	1	2.7279E+01	0.	5.5286E+00	1.7600E+01	1.7463E+00	0.	0
17	0	1	2.4642E+01	0.	7.4148E+00	1.7600E+01	2.0978E+00	0.	0
18	0	1	1.9996E+01	0.	1.0804E+01	1.7600E+01	2.5657E+00	0.	0
19	0	1	1.7878E+01	0.	1.8908E+01	1.7600E+01	3.5110E+00	0.	0.
20	1	1	2.9699E+01	0.	5.4022E+01	1.7600E+01	0.	0.	0.

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0 THE NUMBER OF NATURAL FREQUENCIES REQUESTED IS  9
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NATURAL FREQUENCIES OF HORIZONTAL VIBRATION

FREQUENCY CPS	DEFLECTION SECTION 1	MOMENT	DEFLECTION SECTION 6	MOMENT	DEFLECTION SECTION 10	MOMENT
.00	1.000E+00	5.831E-03	4.869E-01	4.058E-03	7.638E-02	7.735E-04
4.13	1.000E+00	9.217E-03	8.864E-02	2.085E+06	5.131E-01	3.554E+06
7.43	1.000E+00	1.101E-02	5.731E-01	4.268E+06	6.865E-02	3.857E+05
10.87	1.000E+00	1.009E-02	5.883E-01	4.204E+06	7.085E-01	4.945E+06
14.47	1.000E+00	7.835E-03	6.463E-02	4.653E+05	9.482E-02	2.448E+05
17.44	1.000E+00	6.323E-03	5.272E-01	4.011E+06	6.065E-01	4.309E+06
20.41	1.000E+00	5.253E-03	8.024E-01	5.716E+06	1.229E-01	1.161E+06
23.51	1.000E+00	5.583E-03	2.978E-01	1.416E+06	8.242E-01	6.163E+06
25.90	1.000E+00	6.256E-03	5.890E-01	5.784E+06	3.700E-01	3.852E+06

0 THE NUMBER OF NATURAL FREQUENCIES FOUND IS 9
1 GPPP

DEFLECTION SECTION 15	MOMENT	DEFLECTION SECTION 20	MOMENT
4.367E-01	3.564E-03	9.499E-01	5.831E-03
1.359E-01	2.208E+06	7.766E-01	8.757E-03
5.736E-01	4.832E+06	8.132E-01	1.272E-02
5.336E-01	4.443E+06	7.353E-01	1.304E-02
7.403E-02	1.219E+04	4.582E-01	9.018E-03
2.802E-01	3.554E+06	4.559E-01	9.495E-03
8.920E-01	9.381E+06	7.073E-01	1.531E-02
5.533E-01	4.985E+06	4.349E-01	1.002E-02
2.087E-01	1.513E+06	3.621E-01	9.458E-03

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION(USCGC POLAR SEA)

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION(USCGC POLAR SEA)

FREQUENCY .00 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-5.8309E-03	0.	5.8309E-03	0.
2	8.9738E-01	0.	8.9738E-01	0.	-5.7242E-03	0.	5.7242E-03	0.
3	7.9475E-01	0.	7.9475E-01	0.	-5.4957E-03	0.	5.4957E-03	0.
4	6.9213E-01	0.	6.9213E-01	0.	-5.1335E-03	0.	5.1335E-03	0.
5	5.8950E-01	0.	5.8950E-01	0.	-4.6384E-03	0.	4.6384E-03	0.
6	4.8688E-01	0.	4.8688E-01	0.	-4.0582E-03	0.	4.0582E-03	0.
7	3.8426E-01	0.	3.8426E-01	0.	-3.3474E-03	0.	3.3474E-03	0.
8	2.8163E-01	0.	2.8163E-01	0.	-2.5428E-03	0.	2.5428E-03	0.
9	1.7901E-01	0.	1.7901E-01	0.	-1.6772E-03	0.	1.6772E-03	0.
10	7.6384E-02	0.	7.6384E-02	0.	-7.7347E-04	0.	7.7347E-04	0.
11	-2.6240E-02	0.	2.6240E-02	0.	1.4583E-04	0.	1.4583E-04	0.
12	-1.2886E-01	0.	1.2886E-01	0.	1.0598E-03	0.	1.0598E-03	0.
13	-2.3149E-01	0.	2.3149E-01	0.	1.9476E-03	0.	1.9476E-03	0.
14	-3.3411E-01	0.	3.3411E-01	0.	2.7890E-03	0.	2.7890E-03	0.
15	-4.3674E-01	0.	4.3674E-01	0.	3.5639E-03	0.	3.5639E-03	0.
16	-5.3936E-01	0.	5.3936E-01	0.	4.2516E-03	0.	4.2516E-03	0.
17	-6.4198E-01	0.	6.4198E-01	0.	4.8254E-03	0.	4.8254E-03	0.
18	-7.4461E-01	0.	7.4461E-01	0.	5.2765E-03	0.	5.2765E-03	0.
19	-8.4723E-01	0.	8.4723E-01	0.	5.6124E-03	0.	5.6124E-03	0.
20	-9.4986E-01	0.	9.4986E-01	0.	5.8309E-03	0.	5.8309E-03	0.

1 GBRP

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION(USCGC POLAR SEA)

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION(USCGC POLAR SEA)

FREQUENCY 4.13 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-9.2171E-03	0.	9.2171E-03	0.
2	7.7841E-01	0.	7.7841E-01	0.	1.6289E+05	0.	1.6289E+05	0.
3	5.4475E-01	0.	5.4475E-01	0.	4.8703E+05	0.	4.8703E+05	0.
4	3.1407E-01	0.	3.1407E-01	0.	9.5113E+05	0.	9.5113E+05	0.
5	9.8453E-02	0.	9.8453E-02	0.	1.5073E+06	0.	1.5073E+06	0.
6	-8.8644E-02	0.	8.8644E-02	0.	2.0851E+06	0.	2.0851E+06	0.
7	-2.5576E-01	0.	2.5576E-01	0.	2.6267E+06	0.	2.6267E+06	0.
8	-3.8880E-01	0.	3.8880E-01	0.	3.0729E+06	0.	3.0729E+06	0.
9	-4.7580E-01	0.	4.7580E-01	0.	3.3907E+06	0.	3.3907E+06	0.
10	-5.1310E-01	0.	5.1310E-01	0.	3.5536E+06	0.	3.5536E+06	0.
11	-5.0480E-01	0.	5.0480E-01	0.	3.5569E+06	0.	3.5569E+06	0.
12	-4.5780E-01	0.	4.5780E-01	0.	3.4043E+06	0.	3.4043E+06	0.
13	-3.7730E-01	0.	3.7730E-01	0.	3.1095E+06	0.	3.1095E+06	0.
14	-2.6679E-01	0.	2.6679E-01	0.	2.6994E+06	0.	2.6994E+06	0.
15	-1.3591E-01	0.	1.3591E-01	0.	2.2082E+06	0.	2.2082E+06	0.
16	6.1037E-03	0.	6.1037E-03	0.	1.6755E+06	0.	1.6755E+06	0.
17	1.7621E-01	0.	1.7621E-01	0.	1.1449E+06	0.	1.1449E+06	0.
18	3.6574E-01	0.	3.6574E-01	0.	6.6557E+05	0.	6.6557E+05	0.
19	5.6805E-01	0.	5.6805E-01	0.	2.7274E+05	0.	2.7274E+05	0.
20	7.7659E-01	0.	7.7659E-01	0.	-8.7572E-03	0.	8.7572E-03	0.

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NATURAL FREQUENCIES OF HORIZONTAL VIBRATION

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION(USCGC POLAR SEA)

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION(USCGC POLAR SEA)

FREQUENCY 7.43 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-1.1014E-02	0.	1.1014E-02	0.
2	6.1378E-01	0.	6.1378E-01	0.	5.2787E+05	0.	5.2787E+05	0.
3	2.1366E-01	0.	2.1366E-01	0.	1.4677E+06	0.	1.4677E+06	0.
4	-1.3896E-01	0.	1.3896E-01	0.	2.5855E+06	0.	2.5855E+06	0.
5	-4.0448E-01	0.	4.0448E-01	0.	3.5713E+06	0.	3.5713E+06	0.
6	-5.7307E-01	0.	5.7307E-01	0.	4.2681E+06	0.	4.2681E+06	0.
7	-6.1075E-01	0.	6.1075E-01	0.	4.2051E+06	0.	4.2051E+06	0.
8	-5.0811E-01	0.	5.0811E-01	0.	3.4035E+06	0.	3.4035E+06	0.
9	-3.1058E-01	0.	3.1058E-01	0.	2.0585E+06	0.	2.0585E+06	0.
10	-6.8654E-02	0.	6.8654E-02	0.	3.8571E+05	0.	3.8571E+05	0.
11	1.8182E-01	0.	1.8182E-01	0.	-1.3563E+06	0.	1.3563E+06	0.
12	3.7782E-01	0.	3.7782E-01	0.	-2.9163E+06	0.	2.9163E+06	0.
13	5.2348E-01	0.	5.2348E-01	0.	-4.0961E+06	0.	4.0961E+06	0.
14	5.9512E-01	0.	5.9512E-01	0.	-4.7572E+06	0.	4.7572E+06	0.
15	5.7359E-01	0.	5.7359E-01	0.	-4.8324E+06	0.	4.8324E+06	0.
16	4.6931E-01	0.	4.6931E-01	0.	-4.3409E+06	0.	4.3409E+06	0.
17	2.6307E-01	0.	2.6307E-01	0.	-3.3588E+06	0.	3.3588E+06	0.
18	-3.6239E-02	0.	3.6239E-02	0.	-2.1283E+06	0.	2.1283E+06	0.
19	-4.0468E-01	0.	4.0468E-01	0.	-9.2550E+05	0.	9.2550E+05	0.
20	-8.1321E-01	0.	8.1321E-01	0.	1.2722E-02	0.	1.2722E-02	0.

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FREQUENCY 10.87 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-1.0094E-02	0.	1.0094E-02	0.
2	4.0991E-01	0.	4.0991E-01	0.	1.1317E+06	0.	1.1317E+06	0.
3	-1.4298E-01	0.	1.4298E-01	0.	2.8533E+06	0.	2.8533E+06	0.
4	-5.0955E-01	0.	5.0955E-01	0.	4.3196E+06	0.	4.3196E+06	0.
5	-6.3505E-01	0.	6.3505E-01	0.	4.7484E+06	0.	4.7484E+06	0.
6	-5.8830E-01	0.	5.8830E-01	0.	4.2045E+06	0.	4.2045E+06	0.
7	-2.8401E-01	0.	2.8401E-01	0.	1.9885E+06	0.	1.9885E+06	0.
8	1.5801E-01	0.	1.5801E-01	0.	-9.6395E+05	0.	9.6395E+05	0.
9	5.3008E-01	0.	5.3008E-01	0.	-3.5541E+06	0.	3.5541E+06	0.
10	7.0852E-01	0.	7.0852E-01	0.	-4.9447E+06	0.	4.9447E+06	0.
11	6.6968E-01	0.	6.6968E-01	0.	-4.8048E+06	0.	4.8048E+06	0.
12	4.5754E-01	0.	4.5754E-01	0.	-3.2281E+06	0.	3.2281E+06	0.
13	1.2104E-01	0.	1.2104E-01	0.	-6.6392E+05	0.	6.6392E+05	0.
14	-2.5390E-01	0.	2.5390E-01	0.	2.1573E+06	0.	2.1573E+06	0.
15	-5.3362E-01	0.	5.3362E-01	0.	4.4426E+06	0.	4.4426E+06	0.
16	-6.4844E-01	0.	6.4844E-01	0.	5.5976E+06	0.	5.5976E+06	0.
17	-5.9058E-01	0.	5.9058E-01	0.	5.2994E+06	0.	5.2994E+06	0.
18	-3.1510E-01	0.	3.1510E-01	0.	3.8056E+06	0.	3.8056E+06	0.
19	1.4792E-01	0.	1.4792E-01	0.	1.7942E+06	0.	1.7942E+06	0.
20	7.3534E-01	0.	7.3534E-01	0.	-1.3040E-02	0.	1.3040E-02	0.

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NATURAL FREQUENCIES OF HORIZONTAL VIBRATION

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION(USCGC POLAR SEA)

FREQUENCY 14.47 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-7.8351E-03	0.	7.8351E-03	0.
2	1.3201E-01	0.	1.3201E-01	0.	2.0033E+06	0.	2.0033E+06	0.
3	-5.0849E-01	0.	5.0849E-01	0.	4.3429E+06	0.	4.3429E+06	0.
4	-6.7900E-01	0.	6.7900E-01	0.	5.0757E+06	0.	5.0757E+06	0.
5	-4.3563E-01	0.	4.3563E-01	0.	3.3611E+06	0.	3.3611E+06	0.
6	-6.4632E-02	0.	6.4632E-02	0.	4.6528E+05	0.	4.6528E+05	0.
7	3.8807E-01	0.	3.8807E-01	0.	-2.7557E+06	0.	2.7557E+06	0.
8	6.0858E-01	0.	6.0858E-01	0.	-4.1955E+06	0.	4.1955E+06	0.
9	4.7190E-01	0.	4.7190E-01	0.	-3.1653E+06	0.	3.1653E+06	0.
10	9.4817E-02	0.	9.4817E-02	0.	-2.4479E+05	0.	2.4479E+05	0.
11	-3.2206E-01	0.	3.2206E-01	0.	3.0383E+06	0.	3.0383E+06	0.
12	-5.4468E-01	0.	5.4468E-01	0.	5.0982E+06	0.	5.0982E+06	0.
13	-5.3064E-01	0.	5.3064E-01	0.	5.0774E+06	0.	5.0774E+06	0.
14	-2.7657E-01	0.	2.7657E-01	0.	3.0614E+06	0.	3.0614E+06	0.
15	7.4032E-02	0.	7.4032E-02	0.	1.2186E+04	0.	1.2186E+04	0.
16	3.4553E-01	0.	3.4553E-01	0.	-2.7595E+06	0.	2.7595E+06	0.
17	5.1651E-01	0.	5.1651E-01	0.	-4.1604E+06	0.	4.1604E+06	0.
18	4.4055E-01	0.	4.4055E-01	0.	-3.7103E+06	0.	3.7103E+06	0.
19	9.5311E-02	0.	9.5311E-02	0.	-1.9790E+06	0.	1.9790E+06	0.
20	-4.5820E-01	0.	4.5820E-01	0.	9.0182E-03	0.	9.0182E-03	0.

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NATURAL FREQUENCIES OF HORIZONTAL VIBRATION

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION(USCGC POLAR SEA)

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION(USCGC POLAR SEA)

FREQUENCY 17.44 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-6.3228E-03	0.	6.3228E-03	0.
2	-1.7218E-01	0.	1.7218E-01	0.	2.9110E+06	0.	2.9110E+06	0.
3	-7.5668E-01	0.	7.5668E-01	0.	5.1846E+06	0.	5.1846E+06	0.
4	-5.5184E-01	0.	5.5184E-01	0.	3.9840E+06	0.	3.9840E+06	0.
5	4.7453E-02	0.	4.7453E-02	0.	-1.0709E+05	0.	1.0709E+05	0.
6	5.2718E-01	0.	5.2718E-01	0.	-4.0112E+06	0.	4.0112E+06	0.
7	5.4128E-01	0.	5.4128E-01	0.	-4.0611E+06	0.	4.0611E+06	0.
8	3.9672E-02	0.	3.9672E-02	0.	-5.0111E+05	0.	5.0111E+05	0.
9	-4.7723E-01	0.	4.7723E-01	0.	3.2929E+06	0.	3.2929E+06	0.
10	-6.0654E-01	0.	6.0654E-01	0.	4.3092E+06	0.	4.3092E+06	0.
11	-3.1000E-01	0.	3.1000E-01	0.	1.9551E+06	0.	1.9551E+06	0.
12	1.3413E-01	0.	1.3413E-01	0.	-2.1098E+06	0.	2.1098E+06	0.
13	5.0210E-01	0.	5.0210E-01	0.	-5.4302E+06	0.	5.4302E+06	0.
14	5.5821E-01	0.	5.5821E-01	0.	-6.0074E+06	0.	6.0074E+06	0.
15	2.8017E-01	0.	2.8017E-01	0.	-3.5541E+06	0.	3.5541E+06	0.
16	-9.6232E-02	0.	9.6232E-02	0.	4.2577E+05	0.	4.2577E+05	0.
17	-5.0297E-01	0.	5.0297E-01	0.	3.8509E+06	0.	3.8509E+06	0.
18	-6.1568E-01	0.	6.1568E-01	0.	4.6568E+06	0.	4.6568E+06	0.
19	-2.8200E-01	0.	2.8200E-01	0.	2.8611E+06	0.	2.8611E+06	0.
20	4.5587E-01	0.	4.5587E-01	0.	-9.4953E-03	0.	9.4953E-03	0.

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NATURAL FREQUENCIES OF HORIZONTAL VIBRATION

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION(USCGC POLAR SEA)

FREQUENCY 20.41 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-5.2530E-03	0.	5.2530E-03	0.
2	-5.4527E-01	0.	5.4527E-01	0.	3.9863E+06	0.	3.9863E+06	0.
3	-8.5393E-01	0.	8.5393E-01	0.	5.2086E+06	0.	5.2086E+06	0.
4	-1.2060E-01	0.	1.2060E-01	0.	1.0617E+06	0.	1.0617E+06	0.
5	6.0168E-01	0.	6.0168E-01	0.	-3.9501E+06	0.	3.9501E+06	0.
6	8.0236E-01	0.	8.0236E-01	0.	-5.7157E+06	0.	5.7157E+06	0.
7	-1.9439E-02	0.	1.9439E-02	0.	5.5169E+05	0.	5.5169E+05	0.
8	-8.7084E-01	0.	8.7084E-01	0.	6.6416E+06	0.	6.6416E+06	0.
9	-7.4216E-01	0.	7.4216E-01	0.	5.6981E+06	0.	5.6981E+06	0.
10	1.2294E-01	0.	1.2294E-01	0.	-1.1609E+06	0.	1.1609E+06	0.
11	8.6061E-01	0.	8.6061E-01	0.	-7.0844E+06	0.	7.0844E+06	0.
12	8.0542E-01	0.	8.0542E-01	0.	-6.5037E+06	0.	6.5037E+06	0.
13	7.9478E-02	0.	7.9478E-02	0.	1.9947E+05	0.	1.9947E+05	0.
14	-7.2819E-01	0.	7.2819E-01	0.	7.4973E+06	0.	7.4973E+06	0.
15	-8.9196E-01	0.	8.9196E-01	0.	9.3813E+06	0.	9.3813E+06	0.
16	-4.3586E-01	0.	4.3586E-01	0.	4.6101E+06	0.	4.6101E+06	0.
17	5.1381E-01	0.	5.1381E-01	0.	-3.6019E+06	0.	3.6019E+06	0.
18	1.1438E+00	0.	1.1438E+00	0.	-8.1498E+06	0.	8.1498E+06	0.
19	7.7481E-01	0.	7.7481E-01	0.	-6.0792E+06	0.	6.0792E+06	0.
20	-7.0733E-01	0.	7.0733E-01	0.	1.5307E-02	0.	1.5307E-02	0.

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NATURAL FREQUENCIES OF HORIZONTAL VIBRATION(USCGC POLAR SEA)

FREQUENCY 23.51 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-5.5835E-03	0.	5.5835E-03	0.
2	-1.0267E+00	0.	1.0267E+00	0.	5.2915E+06	0.	5.2915E+06	0.
3	-6.7226E-01	0.	6.7226E-01	0.	3.6741E+06	0.	3.6741E+06	0.
4	5.7020E-01	0.	5.7020E-01	0.	-3.5541E+06	0.	3.5541E+06	0.
5	8.0100E-01	0.	8.0100E-01	0.	-5.3533E+06	0.	5.3533E+06	0.
6	2.9784E-01	0.	2.9784E-01	0.	-1.4159E+06	0.	1.4159E+06	0.
7	-7.5491E-01	0.	7.5491E-01	0.	6.4798E+06	0.	6.4798E+06	0.
8	-6.1139E-01	0.	6.1139E-01	0.	5.2234E+06	0.	5.2234E+06	0.
9	4.0035E-01	0.	4.0035E-01	0.	-2.5877E+06	0.	2.5877E+06	0.
10	8.2417E-01	0.	8.2417E-01	0.	-6.1630E+06	0.	6.1630E+06	0.
11	2.2842E-01	0.	2.2842E-01	0.	-1.4135E+06	0.	1.4135E+06	0.
12	-5.3212E-01	0.	5.3212E-01	0.	5.6275E+06	0.	5.6275E+06	0.
13	-7.2765E-01	0.	7.2765E-01	0.	7.2992E+06	0.	7.2992E+06	0.
14	-1.1906E-01	0.	1.1906E-01	0.	1.7445E+06	0.	1.7445E+06	0.
15	5.5328E-01	0.	5.5328E-01	0.	-4.9852E+06	0.	4.9852E+06	0.
16	6.3834E-01	0.	6.3834E-01	0.	-6.2350E+06	0.	6.2350E+06	0.
17	2.7149E-02	0.	2.7149E-02	0.	-7.9573E+05	0.	7.9573E+05	0.
18	-7.3369E-01	0.	7.3369E-01	0.	4.9005E+06	0.	4.9005E+06	0.
19	-7.3123E-01	0.	7.3123E-01	0.	4.9612E+06	0.	4.9612E+06	0.
20	4.3487E-01	0.	4.3487E-01	0.	-1.0023E-02	0.	1.0023E-02	0.

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NATURAL FREQUENCIES OF HORIZONTAL VIBRATION

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION

NATURAL FREQUENCIES OF HORIZONTAL VIBRATION(USCGC POLAR SEA)

FREQUENCY 25.90 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-6.2557E-03	0.	6.2557E-03	0.
2	-1.4495E+00	0.	1.4495E+00	0.	6.4191E+06	0.	6.4191E+06	0.
3	-2.2239E-01	0.	2.2239E-01	0.	1.0058E+06	0.	1.0058E+06	0.
4	1.0632E+00	0.	1.0632E+00	0.	-6.6591E+06	0.	6.6591E+06	0.
5	3.6981E-01	0.	3.6981E-01	0.	-2.0438E+06	0.	2.0438E+06	0.
6	-5.8903E-01	0.	5.8903E-01	0.	5.7843E+06	0.	5.7843E+06	0.
7	-4.2287E-01	0.	4.2287E-01	0.	4.1163E+06	0.	4.1163E+06	0.
8	6.1899E-01	0.	6.1899E-01	0.	-3.7708E+06	0.	3.7708E+06	0.
9	5.6850E-01	0.	5.6850E-01	0.	-3.6076E+06	0.	3.6076E+06	0.
10	-3.7002E-01	0.	3.7002E-01	0.	3.8524E+06	0.	3.8524E+06	0.
11	-7.4155E-01	0.	7.4155E-01	0.	6.7783E+06	0.	6.7783E+06	0.
12	-1.1596E-01	0.	1.1596E-01	0.	6.7953E+05	0.	6.7953E+05	0.
13	6.7871E-01	0.	6.7871E-01	0.	-6.8387E+06	0.	6.8387E+06	0.
14	5.8759E-01	0.	5.8759E-01	0.	-6.1803E+06	0.	6.1803E+06	0.
15	-2.0872E-01	0.	2.0872E-01	0.	1.5128E+06	0.	1.5128E+06	0.
16	-6.5470E-01	0.	6.5470E-01	0.	6.6980E+06	0.	6.6980E+06	0.
17	-3.2637E-01	0.	3.2637E-01	0.	3.5608E+06	0.	3.5608E+06	0.
18	5.5779E-01	0.	5.5779E-01	0.	-3.3241E+06	0.	3.3241E+06	0.
19	8.0409E-01	0.	8.0409E-01	0.	-5.0115E+06	0.	5.0115E+06	0.
20	-3.6211E-01	0.	3.6211E-01	0.	9.4580E-03	0.	9.4580E-03	0.

USCGC POLAR SEA

20-SECTION NON-UNIFORM BEAM SYSTEM

NATURAL FREQUENCIES AND MODE SHAPES CALCULATION
IN VERTICAL MODE OF VIBRATION

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0CASE TITLE- NATURAL FREQUENCY IN VERTICAL BENDING
00PTION DATA
  20        0   0   0   0   0   0   0   0   0   1
00PTION DATA
  21        1   6  10  15  20   0   0   0   0   0
0GENERAL DATA -  NUMBER OF SECTIONS   20
                 FREQUENCY RANGE FROM       .000 CPS  TO   200.000 CPS
                 FREQUENCY INTERVAL     .500 CPS
                 POWER OF FREQUENCY =  0.000
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REAL PARTS OF SCALING FACTORS

0SECTION-END	CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX (N,N+1)	P(N)/Y
	1	1.0000E+00	0.	1.0000E-10	1.0000E+00	1.0000E-06	0.	1.0000E+00

PARAMETER VALUES FOR EACH SECTION - UNSCALED

0SECTION-END	CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI(N)	DX(N,N+1)	DX/KAG(N,N+1)	IMZ*DX (N,N+1)	P(N)/Y
1	1 1	9.1110E+00	0.	1.7190E+01	1.7600E+01	1.3670E+01	0.	0.
2	0 1	1.3997E+01	0.	1.1123E+01	1.7600E+01	7.5805E+00	0.	0.
3	0 1	2.1023E+01	0.	9.6972E+00	1.7600E+01	4.7649E+00	0.	0.
4	0 1	2.7602E+01	0.	9.0477E+00	1.7600E+01	3.1766E+00	0.	0.
5	0 1	2.4804E+01	0.	9.3612E+00	1.7600E+01	3.6659E+00	0.	0.
6	0 1	4.4804E+01	0.	9.3381E+00	1.7600E+01	4.3543E+00	0.	0.
7	0 1	4.5904E+01	0.	9.3381E+00	1.7600E+01	4.6325E+00	0.	0.
8	0 1	4.5157E+01	0.	9.3381E+00	1.7600E+01	4.5691E+00	0.	0.
9	0 1	4.6903E+01	0.	9.3381E+00	1.7600E+01	4.2902E+00	0.	0.
10	0 1	4.7151E+01	0.	9.3381E+00	1.7600E+01	4.0479E+00	0.	0.
11	0 1	4.7588E+01	0.	9.3381E+00	1.7600E+01	3.7903E+00	0.	0.
12	0 1	4.7828E+01	0.	9.3381E+00	1.7600E+01	3.5258E+00	0.	0.
13	0 1	4.7202E+01	0.	9.4077E+00	1.7600E+01	3.3354E+00	0.	0.
14	0 1	4.5579E+01	0.	9.4312E+00	1.7600E+01	3.1949E+00	0.	0.
15	0 1	4.1535E+01	0.	9.4547E+00	1.7600E+01	3.0322E+00	0.	0.
16	0 1	3.8103E+01	0.	9.4547E+00	1.7600E+01	2.8655E+00	0.	0.
17	0 1	3.0890E+01	0.	9.5503E+00	1.7600E+01	2.6683E+00	0.	0.
18	0 1	2.1052E+01	0.	1.0505E+01	1.7600E+01	2.8508E+00	0.	0.
19	0 1	1.4974E+01	0.	1.4218E+01	1.7600E+01	3.8984E+00	0.	0.
20	1 1	2.4771E+01	0.	3.5017E+01	1.7600E+01	0.	0.	1.0000E+00

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0 THE NUMBER OF NATURAL FREQUENCIES REQUESTED IS  9
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VERTICAL NATURAL FREQUENCY

FREQUENCY CPS	DEFLECTION SECTION 1	MOMENT	DEFLECTION SECTION 6	MOMENT	DEFLECTION SECTION 10	MOMENT
.00	1.000E+00	1.105E-01	1.073E+01	3.887E-01	1.851E+01	7.360E-01
2.74	1.000E+00	7.863E-03	1.055E-01	8.595E+05	4.312E-01	1.827E+06
5.00	1.000E+00	9.547E-03	3.380E-01	1.980E+06	1.434E-01	6.677E+05
7.26	1.000E+00	8.889E-03	5.027E-01	2.530E+06	5.090E-01	1.417E+06
9.46	1.000E+00	7.610E-03	3.742E-01	1.730E+06	1.556E-01	4.755E+05
11.52	1.000E+00	5.309E-03	9.069E-03	1.357E+05	4.470E-01	1.839E+06
13.38	1.000E+00	3.484E-03	3.671E-01	1.654E+06	5.344E-02	6.177E+04
15.22	1.000E+00	1.906E-03	5.905E-01	2.674E+06	5.969E-01	2.487E+06
16.99	1.000E+00	1.467E-03	4.892E-01	2.279E+06	4.983E-02	1.870E+05

DEFLECTION SECTION 15	MOMENT	DEFLECTION SECTION 20	MOMENT
2.823E+01	1.021E+00	3.796E+01	1.111E+00
2.566E-02	1.067E+06	8.538E-01	1.009E+00
3.622E-01	1.965E+06	6.609E-01	9.907E-01
4.439E-01	2.749E+06	6.326E-01	1.010E+00
3.367E-01	2.172E+06	5.852E-01	9.899E-01
5.224E-02	6.461E+05	4.386E-01	1.008E+00
1.886E-01	6.351E+05	4.089E-01	9.924E-01
4.461E-01	2.134E+06	4.340E-01	1.008E+00
6.059E-01	3.042E+06	4.515E-01	9.913E-01

0 THE NUMBER OF NATURAL FREQUENCIES FOUND IS 9
1 GBRF

VERTICAL NATURAL FREQUENCY

NATURAL FREQUENCY IN VERTICAL BENDING

VERTICAL NATURAL FREQUENCY

NATURAL FREQUENCY IN VERTICAL BENDING

FREQUENCY .00 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	1.1051E-01	0.	1.1051E-01	0.
2	2.9450E+00	0.	2.9450E+00	0.	9.0951E-03	0.	9.0951E-03	0.
3	4.8901E+00	0.	4.8901E+00	0.	-9.2020E-02	0.	9.2020E-02	0.
4	6.8351E+00	0.	6.8351E+00	0.	-1.9238E-01	0.	1.9238E-01	0.
5	8.7801E+00	0.	8.7801E+00	0.	-2.9136E-01	0.	2.9136E-01	0.
6	1.0725E+01	0.	1.0725E+01	0.	-3.8874E-01	0.	3.8874E-01	0.
7	1.2670E+01	0.	1.2670E+01	0.	-4.8259E-01	0.	4.8259E-01	0.
8	1.4615E+01	0.	1.4615E+01	0.	-5.7218E-01	0.	5.7218E-01	0.
9	1.6560E+01	0.	1.6560E+01	0.	-6.5693E-01	0.	6.5693E-01	0.
10	1.8505E+01	0.	1.8505E+01	0.	-7.3597E-01	0.	7.3597E-01	0.
11	2.0450E+01	0.	2.0450E+01	0.	-8.0862E-01	0.	8.0862E-01	0.
12	2.2395E+01	0.	2.2395E+01	0.	-8.7413E-01	0.	8.7413E-01	0.
13	2.4340E+01	0.	2.4340E+01	0.	-9.3177E-01	0.	9.3177E-01	0.
14	2.6285E+01	0.	2.6285E+01	0.	-9.8099E-01	0.	9.8099E-01	0.
15	2.8230E+01	0.	2.8230E+01	0.	-1.0214E+00	0.	1.0214E+00	0.
16	3.0175E+01	0.	3.0175E+01	0.	-1.0533E+00	0.	1.0533E+00	0.
17	3.2120E+01	0.	3.2120E+01	0.	-1.0766E+00	0.	1.0766E+00	0.
18	3.4065E+01	0.	3.4065E+01	0.	-1.0928E+00	0.	1.0928E+00	0.
19	3.6011E+01	0.	3.6011E+01	0.	-1.1036E+00	0.	1.1036E+00	0.
20	3.7956E+01	0.	3.7956E+01	0.	-1.1105E+00	0.	1.1105E+00	0.

1 GBRP

FREQUENCY . 2.74 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-7.8629E-03	0.	7.8629E-03	0.
2	8.2462E-01	0.	8.2462E-01	0.	4.7623E+04	0.	4.7623E+04	0.
3	6.4067E-01	0.	6.4067E-01	0.	1.5558E+05	0.	1.5558E+05	0.
4	4.5758E-01	0.	4.5758E-01	0.	3.3393E+05	0.	3.3393E+05	0.
5	2.8399E-01	0.	2.8399E-01	0.	5.7831E+05	0.	5.7831E+05	0.
6	1.0547E-01	0.	1.0547E-01	0.	8.5950E+05	0.	8.5950E+05	0.
7	-7.6038E-02	0.	7.6038E-02	0.	1.1654E+06	0.	1.1654E+06	0.
8	-2.3843E-01	0.	2.3843E-01	0.	1.4530E+06	0.	1.4530E+06	0.
9	-3.6129E-01	0.	3.6129E-01	0.	1.6844E+06	0.	1.6844E+06	0.
10	-4.3121E-01	0.	4.3121E-01	0.	1.8272E+06	0.	1.8272E+06	0.
11	-4.4469E-01	0.	4.4469E-01	0.	1.8637E+06	0.	1.8637E+06	0.
12	-4.0318E-01	0.	4.0318E-01	0.	1.7897E+06	0.	1.7897E+06	0.
13	-3.1319E-01	0.	3.1319E-01	0.	1.6148E+06	0.	1.6148E+06	0.
14	-1.8370E-01	0.	1.8370E-01	0.	1.3626E+06	0.	1.3626E+06	0.
15	-2.5665E-02	0.	2.5665E-02	0.	1.0667E+06	0.	1.0667E+06	0.
16	1.4835E-01	0.	1.4835E-01	0.	7.6522E+05	0.	7.6522E+05	0.
17	3.2742E-01	0.	3.2742E-01	0.	4.9327E+05	0.	4.9327E+05	0.
18	5.0373E-01	0.	5.0373E-01	0.	2.7420E+05	0.	2.7420E+05	0.
19	6.7840E-01	0.	6.7840E-01	0.	1.1055E+05	0.	1.1055E+05	0.
20	8.5381E-01	0.	8.5381E-01	0.	-1.0086E+00	0.	1.0086E+00	0.

1 GBRP

VERTICAL NATURAL FREQUENCY

NATURAL FREQUENCY IN VERTICAL BENDING

VERTICAL NATURAL FREQUENCY

NATURAL FREQUENCY IN VERTICAL BENDING

FREQUENCY 5.00 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-9.5468E-03	0.	9.5468E-03	0.
2	7.0908E-01	0.	7.0908E-01	0.	1.5823E+05	0.	1.5823E+05	0.
3	4.0176E-01	0.	4.0176E-01	0.	4.8882E+05	0.	4.8882E+05	0.
4	1.1597E-01	0.	1.1597E-01	0.	9.6610E+05	0.	9.6610E+05	0.
5	-1.2141E-01	0.	1.2141E-01	0.	1.4990E+06	0.	1.4990E+06	0.
6	-3.3801E-01	0.	3.3801E-01	0.	1.9795E+06	0.	1.9795E+06	0.
7	-4.7580E-01	0.	4.7580E-01	0.	2.1971E+06	0.	2.1971E+06	0.
8	-4.8109E-01	0.	4.8109E-01	0.	2.0354E+06	0.	2.0354E+06	0.
9	-3.5556E-01	0.	3.5556E-01	0.	1.4963E+06	0.	1.4963E+06	0.
10	-1.4338E-01	0.	1.4338E-01	0.	6.6767E+05	0.	6.6767E+05	0.
11	9.5365E-02	0.	9.5365E-02	0.	-2.7839E+05	0.	2.7839E+05	0.
12	2.9872E-01	0.	2.9872E-01	0.	-1.1456E+06	0.	1.1456E+06	0.
13	4.2050E-01	0.	4.2050E-01	0.	-1.7648E+06	0.	1.7648E+06	0.
14	4.4104E-01	0.	4.4104E-01	0.	-2.0392E+06	0.	2.0392E+06	0.
15	3.6217E-01	0.	3.6217E-01	0.	-1.9645E+06	0.	1.9645E+06	0.
16	2.0629E-01	0.	2.0629E-01	0.	-1.6286E+06	0.	1.6286E+06	0.
17	4.2643E-03	0.	4.2643E-03	0.	-1.1562E+06	0.	1.1562E+06	0.
18	-2.1225E-01	0.	2.1225E-01	0.	-6.8145E+05	0.	6.8145E+05	0.
19	-4.3371E-01	0.	4.3371E-01	0.	-2.8433E+05	0.	2.8433E+05	0.
20	-6.6094E-01	0.	6.6094E-01	0.	-9.9067E-01	0.	9.9067E-01	0.

1 GBRP

FREQUENCY 7.26 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-8.8888E-03	0.	8.8888E-03	0.
2	5.8412E-01	0.	5.8412E-01	0.	3.3402E+05	0.	3.3402E+05	0.
3	1.6125E-01	0.	1.6125E-01	0.	9.6778E+05	0.	9.6778E+05	0.
4	-1.7736E-01	0.	1.7736E-01	0.	1.7258E+06	0.	1.7258E+06	0.
5	-3.8769E-01	0.	3.8769E-01	0.	2.3044E+06	0.	2.3044E+06	0.
6	-5.0271E-01	0.	5.0271E-01	0.	2.5304E+06	0.	2.5304E+06	0.
7	-3.8069E-01	0.	3.8069E-01	0.	1.9307E+06	0.	1.9307E+06	0.
8	-4.8833E-02	0.	4.8833E-02	0.	6.9034E+05	0.	6.9034E+05	0.
9	3.1089E-01	0.	3.1089E-01	0.	-6.3086E+05	0.	6.3086E+05	0.
10	5.0900E-01	0.	5.0900E-01	0.	-1.4175E+06	0.	1.4175E+06	0.
11	4.7062E-01	0.	4.7062E-01	0.	-1.3243E+06	0.	1.3243E+06	0.
12	2.3502E-01	0.	2.3502E-01	0.	-4.1000E+05	0.	4.1000E+05	0.
13	-7.6133E-02	0.	7.6133E-02	0.	9.1636E+05	0.	9.1636E+05	0.
14	-3.3279E-01	0.	3.3279E-01	0.	2.1110E+06	0.	2.1110E+06	0.
15	-4.4393E-01	0.	4.4393E-01	0.	2.7495E+06	0.	2.7495E+06	0.
16	-3.8695E-01	0.	3.8695E-01	0.	2.7120E+06	0.	2.7120E+06	0.
17	-1.9720E-01	0.	1.9720E-01	0.	2.1340E+06	0.	2.1340E+06	0.
18	5.5811E-02	0.	5.5811E-02	0.	1.3327E+06	0.	1.3327E+06	0.
19	3.3479E-01	0.	3.3479E-01	0.	5.7446E+05	0.	5.7446E+05	0.
20	6.3257E-01	0.	6.3257E-01	0.	-1.0097E+00	0.	1.0097E+00	0.

1 GBRP

VERTICAL NATURAL FREQUENCY

NATURAL FREQUENCY IN VERTICAL BENDING

VERTICAL NATURAL FREQUENCY

NATURAL FREQUENCY IN VERTICAL BENDING

FREQUENCY 9.46 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-7.6101E-03	0.	7.6101E-03	0.
2	4.2570E-01	0.	4.2570E-01	0.	5.6696E+05	0.	5.6696E+05	0.
3	-1.0103E-01	0.	1.0103E-01	0.	1.5047E+06	0.	1.5047E+06	0.
4	-4.1628E-01	0.	4.1628E-01	0.	2.3103E+06	0.	2.3103E+06	0.
5	-4.9300E-01	0.	4.9300E-01	0.	2.4008E+06	0.	2.4008E+06	0.
6	-3.7418E-01	0.	3.7418E-01	0.	1.7305E+06	0.	1.7305E+06	0.
7	5.7400E-02	0.	5.7400E-02	0.	1.6861E+04	0.	1.6861E+04	0.
8	4.7319E-01	0.	4.7319E-01	0.	-1.5328E+06	0.	1.5328E+06	0.
9	5.1301E-01	0.	5.1301E-01	0.	-1.7528E+06	0.	1.7528E+06	0.
10	1.5555E-01	0.	1.5555E-01	0.	-4.7545E+05	0.	4.7545E+05	0.
11	-2.9710E-01	0.	2.9710E-01	0.	1.2583E+06	0.	1.2583E+06	0.
12	-5.1423E-01	0.	5.1423E-01	0.	2.1122E+06	0.	2.1122E+06	0.
13	-3.7721E-01	0.	3.7721E-01	0.	1.4357E+06	0.	1.4357E+06	0.
14	-1.3771E-02	0.	1.3771E-02	0.	-3.4885E+05	0.	3.4885E+05	0.
15	3.3672E-01	0.	3.3672E-01	0.	-2.1724E+06	0.	2.1724E+06	0.
16	4.8427E-01	0.	4.8427E-01	0.	-3.1257E+06	0.	3.1257E+06	0.
17	3.8383E-01	0.	3.8383E-01	0.	-2.9307E+06	0.	2.9307E+06	0.
18	1.2446E-01	0.	1.2446E-01	0.	-1.9979E+06	0.	1.9979E+06	0.
19	-2.0794E-01	0.	2.0794E-01	0.	-9.0208E+05	0.	9.0208E+05	0.
20	-5.8522E-01	0.	5.8522E-01	0.	-9.8992E-01	0.	9.8992E-01	0.

1 GBRP

VERTICAL NATURAL FREQUENCY

NATURAL FREQUENCY IN VERTICAL BENDING

NAIURAL FREQUENCY IN VERTICAL BENDING

FREQUENCY 11.52 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-5.3090E-03	0.	5.3090E-03	0.
2	2.5379E-01	0.	2.5379E-01	0.	8.4044E+05	0.	8.4044E+05	0.
3	-3.2632E-01	0.	3.2632E-01	0.	2.0086E+06	0.	2.0086E+06	0.
4	-5.1395E-01	0.	5.1395E-01	0.	2.5439E+06	0.	2.5439E+06	0.
5	-3.7658E-01	0.	3.7658E-01	0.	1.7706E+06	0.	1.7706E+06	0.
6	-9.0692E-03	0.	9.0692E-03	0.	1.3569E+05	0.	1.3569E+05	0.
7	4.3389E-01	0.	4.3389E-01	0.	-1.5367E+06	0.	1.5367E+06	0.
8	3.9444E-01	0.	3.9444E-01	0.	-1.3718E+06	0.	1.3718E+06	0.
9	-9.3504E-02	0.	9.3504E-02	0.	4.3609E+05	0.	4.3609E+05	0.
10	-4.4702E-01	0.	4.4702E-01	0.	1.8395E+06	0.	1.8395E+06	0.
11	-3.0381E-01	0.	3.0381E-01	0.	1.2985E+06	0.	1.2985E+06	0.
12	1.4003E-01	0.	1.4003E-01	0.	-5.7602E+05	0.	5.7602E+05	0.
13	4.2247E-01	0.	4.2247E-01	0.	-1.8328E+06	0.	1.8328E+06	0.
14	3.1236E-01	0.	3.1236E-01	0.	-1.2500E+06	0.	1.2500E+06	0.
15	-5.2245E-02	0.	5.2245E-02	0.	6.4607E+05	0.	6.4607E+05	0.
16	-3.5409E-01	0.	3.5409E-01	0.	2.3420E+06	0.	2.3420E+06	0.
17	-3.9827E-01	0.	3.9827E-01	0.	2.7933E+06	0.	2.7933E+06	0.
18	-2.1839E-01	0.	2.1839E-01	0.	2.1098E+06	0.	2.1098E+06	0.
19	7.6278E-02	0.	7.6278E-02	0.	1.0022E+06	0.	1.0022E+06	0.
20	4.3862E-01	0.	4.3862E-01	0.	-1.0080E+00	0.	1.0080E+00	0.

GORP

VERTICAL NATURAL FREQUENCY

NATURAL FREQUENCY IN VERTICAL BENDING

FREQUENCY 13.38 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-3.4844E-03	0.	3.4844E-03	0.
2	5.8624E-02	0.	5.8624E-02	0.	1.1331E+06	0.	1.1331E+06	0.
3	-5.1249E-01	0.	5.1249E-01	0.	2.3682E+06	0.	2.3682E+06	0.
4	-4.8285E-01	0.	4.8285E-01	0.	2.2634E+06	0.	2.2634E+06	0.
5	-1.2747E-01	0.	1.2747E-01	0.	5.0116E+05	0.	5.0116E+05	0.
6	3.6705E-01	0.	3.6705E-01	0.	-1.6543E+06	0.	1.6543E+06	0.
7	4.1271E-01	0.	4.1271E-01	0.	-1.7645E+06	0.	1.7645E+06	0.
8	-1.8902E-01	0.	1.8902E-01	0.	4.8129E+05	0.	4.8129E+05	0.
9	-4.9918E-01	0.	4.9918E-01	0.	1.6656E+06	0.	1.6656E+06	0.
10	-5.3444E-02	0.	5.3444E-02	0.	-6.1773E+04	0.	6.1773E+04	0.
11	4.3957E-01	0.	4.3957E-01	0.	-2.1025E+06	0.	2.1025E+06	0.
12	3.0793E-01	0.	3.0793E-01	0.	-1.5419E+06	0.	1.5419E+06	0.
13	-2.0755E-01	0.	2.0755E-01	0.	8.5036E+05	0.	8.5036E+05	0.
14	-4.5217E-01	0.	4.5217E-01	0.	2.0243E+06	0.	2.0243E+06	0.
15	-1.8856E-01	0.	1.8856E-01	0.	6.3510E+05	0.	6.3510E+05	0.
16	2.4058E-01	0.	2.4058E-01	0.	-1.7280E+06	0.	1.7280E+06	0.
17	4.3298E-01	0.	4.3298E-01	0.	-2.9512E+06	0.	2.9512E+06	0.
18	3.0990E-01	0.	3.0990E-01	0.	-2.5111E+06	0.	2.5111E+06	0.
19	4.4103E-03	0.	4.4103E-03	0.	-1.2597E+06	0.	1.2597E+06	0.
20	-4.0891E-01	0.	4.0891E-01	0.	-9.9237E-01	0.	9.9237E-01	0.

1 GBRP

VERTICAL NATURAL FREQUENCY

NATURAL FREQUENCY IN VERTICAL BENDING

FREQUENCY 15.22 CPS

STATION	DEFLECTIONS REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	MOMENT REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-1.9058E-03	0.	1.9058E-03	0.
2	-1.7326E-01	0.	1.7326E-01	0.	1.4674E+06	0.	1.4674E+06	0.
3	-6.4186E-01	0.	6.4186E-01	0.	2.5442E+06	0.	2.5442E+06	0.
4	-3.0641E-01	0.	3.0641E-01	0.	1.4477E+06	0.	1.4477E+06	0.
5	1.9900E-01	0.	1.9900E-01	0.	-1.0109E+06	0.	1.0109E+06	0.
6	5.9052E-01	0.	5.9052E-01	0.	-2.6745E+06	0.	2.6745E+06	0.
7	-5.1070E-02	0.	5.1070E-02	0.	-7.6963E+04	0.	7.6963E+04	0.
8	-6.3560E-01	0.	6.3560E-01	0.	2.1430E+06	0.	2.1430E+06	0.
9	2.3146E-02	0.	2.3146E-02	0.	-2.5964E+05	0.	2.5964E+05	0.
10	5.9693E-01	0.	5.9693E-01	0.	-2.4874E+06	0.	2.4874E+06	0.
11	5.6589E-02	0.	5.6589E-02	0.	-1.8215E+05	0.	1.8215E+05	0.
12	-5.4641E-01	0.	5.4641E-01	0.	2.5569E+06	0.	2.5569E+06	0.
13	-2.2304E-01	0.	2.2304E-01	0.	1.0869E+06	0.	1.0869E+06	0.
14	4.2376E-01	0.	4.2376E-01	0.	-2.0788E+06	0.	2.0788E+06	0.
15	4.4610E-01	0.	4.4610E-01	0.	-2.1337E+06	0.	2.1337E+06	0.
16	-8.1691E-02	0.	8.1691E-02	0.	7.9558E+05	0.	7.9558E+05	0.
17	-4.8688E-01	0.	4.8688E-01	0.	3.2235E+06	0.	3.2235E+06	0.
18	-4.4345E-01	0.	4.4345E-01	0.	3.2292E+06	0.	3.2292E+06	0.
19	-9.6839E-02	0.	9.6839E-02	0.	1.7314E+06	0.	1.7314E+06	0.
20	4.3398E-01	0.	4.3398E-01	0.	-1.0084E+00	0.	1.0084E+00	0.

1 GBRP

VERTICAL NATURAL FREQUENCY

NATURAL FREQUENCY IN VERTICAL BENDING

FREQUENCY 16.99 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	-1.4666E-03	0.	1.4666E-03	0.
2	-4.4465E-01	0.	4.4465E-01	0.	1.8267E+06	0.	1.8267E+06	0.
3	-6.8403E-01	0.	6.8403E-01	0.	2.4056E+06	0.	2.4056E+06	0.
4	-9.1559E-03	0.	9.1559E-03	0.	1.0125E+05	0.	1.0125E+05	0.
5	4.6852E-01	0.	4.6852E-01	0.	-2.2538E+06	0.	2.2538E+06	0.
6	4.8922E-01	0.	4.8922E-01	0.	-2.2788E+06	0.	2.2788E+06	0.
7	-6.1383E-01	0.	6.1383E-01	0.	2.0909E+06	0.	2.0909E+06	0.
8	-2.6458E-01	0.	2.6458E-01	0.	8.1111E+05	0.	8.1111E+05	0.
9	7.1527E-01	0.	7.1527E-01	0.	-2.8641E+06	0.	2.8641E+06	0.
10	-4.9829E-02	0.	4.9829E-02	0.	1.8704E+05	0.	1.8704E+05	0.
11	-6.6151E-01	0.	6.6151E-01	0.	2.7671E+06	0.	2.7671E+06	0.
12	1.6932E-01	0.	1.6932E-01	0.	-9.6443E+05	0.	9.6443E+05	0.
13	6.0295E-01	0.	6.0295E-01	0.	-3.0723E+06	0.	3.0723E+06	0.
14	-1.1850E-01	0.	1.1850E-01	0.	5.2610E+05	0.	5.2610E+05	0.
15	-6.0591E-01	0.	6.0591E-01	0.	3.0416E+06	0.	3.0416E+06	0.
16	-1.5013E-01	0.	1.5013E-01	0.	5.1120E+05	0.	5.1120E+05	0.
17	4.7692E-01	0.	4.7692E-01	0.	-3.1661E+06	0.	3.1661E+06	0.
18	5.6174E-01	0.	5.6174E-01	0.	-3.8897E+06	0.	3.8897E+06	0.
19	1.9809E-01	0.	1.9809E-01	0.	-2.2422E+06	0.	2.2422E+06	0.
20	-4.5146E-01	0.	4.5146E-01	0.	-9.9131E-01	0.	9.9131E-01	0.

USCGC POLAR SEA

20-SECTION NON-UNIFORM BEAM SYSTEM

NATURAL FREQUENCIES AND MODE SHAPES CALCULATION
IN LONGITUDINAL MODE OF VIBRATION

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OCASE TITLE- NATURAL FREQUENCIES (LONGITUDINAL)
OOPTION DATA
  20        0   0   0   0   0   0   0   0   0   1
OGENERAL DATA -  NUMBER OF SECTIONS   20
                 FREQUENCY RANGE FROM       .000 CPS  TO  2000.000 CPS
                 FREQUENCY INTERVAL     .500 CPS
                 POWER OF FREQUENCY =  0.000
```

REAL PARTS OF SCALING FACTORS

OSECTION-END	CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI (N)	DX(N,N+1) (N,N+1)	DX/KAG (N,N+1)	IMZ*DX (N,N+1)	P(N)/Y
	1	1.0000E+00	0.	0.	0.	0.	0.	0.

PARAMETER VALUES FOR EACH SECTION - UNSCALED

OSECTION-END	CONDN-SYSTEM	MASS	WATER INERTIA	DX/EI (N)	DX(N,N+1) (N,N+1)	DX/KAG (N,N+1)	IMZ*DX (N,N+1)	P(N)/Y
1	1 1	8.5830E+00	0.	0.	0.	0.	0.	0.
2	0 1	1.1357E+01	0.	0.	0.	0.	0.	0.
3	0 1	1.5391E+01	0.	0.	0.	0.	0.	0.
4	0 1	1.8802E+01	0.	0.	0.	0.	0.	0.
5	0 1	1.2660E+01	0.	0.	0.	0.	0.	0.
6	0 1	2.8612E+01	0.	0.	0.	0.	0.	0.
7	0 1	2.5928E+01	0.	0.	0.	0.	0.	0.
8	0 1	2.2365E+01	0.	0.	0.	0.	0.	0.
9	0 1	2.1911E+01	0.	0.	0.	0.	0.	0.
10	0 1	2.0575E+01	0.	0.	0.	0.	0.	0.
11	0 1	3.0308E+01	0.	0.	0.	0.	0.	0.
12	0 1	2.0548E+01	0.	0.	0.	0.	0.	0.
13	0 1	2.0221E+01	0.	0.	0.	0.	0.	0.
14	0 1	2.0235E+01	0.	0.	0.	0.	0.	0.
15	0 1	2.0415E+01	0.	0.	0.	0.	0.	0.
16	0 1	2.1911E+01	0.	0.	0.	0.	0.	0.
17	0 1	1.9098E+01	0.	0.	0.	0.	0.	0.
18	0 1	1.4012E+01	0.	0.	0.	0.	0.	0.
19	0 1	1.1806E+01	0.	0.	0.	0.	0.	0.
20	1 1	2.3891E+01	0.	0.	0.	0.	0.	0.

REAL PARTS OF SCALING FACTORS

0 N	M	SYSTEM	K(N,M)	C(N,M)	C(N,M)/W	DX(N,M)	DX/KAG (N,M)	IMZ*DX (N,M)	Q(N,M) /Y
		1	1.0000E+06	0.	0.	0.	0.	0.	0.

PARAMETER VALUES FOR SPECIAL CONNECTIONS

0 N	M	SYSTEM	K(N,M)	C(N,M)	C(N,M)/W	DX(N,M)	DX/KAG (N,M)	IMZ*DX (N,M)	Q(N,M) /Y
1	2	1	5.6965E-01	0.	0.	0.	0.	0.	0.
2	3	1	9.7214E-01	0.	0.	0.	0.	0.	0.
3	4	1	1.3904E+00	0.	0.	0.	0.	0.	0.
4	5	1	1.8049E+00	0.	0.	0.	0.	0.	0.
5	6	1	1.9488E+00	0.	0.	0.	0.	0.	0.
6	7	1	1.8079E+00	0.	0.	0.	0.	0.	0.
7	8	1	1.6767E+00	0.	0.	0.	0.	0.	0.
8	9	1	1.6752E+00	0.	0.	0.	0.	0.	0.
9	10	1	1.7801E+00	0.	0.	0.	0.	0.	0.
10	11	1	1.9188E+00	0.	0.	0.	0.	0.	0.
11	12	1	2.0650E+00	0.	0.	0.	0.	0.	0.
12	13	1	2.0972E+00	0.	0.	0.	0.	0.	0.
13	14	1	2.1017E+00	0.	0.	0.	0.	0.	0.
14	15	1	2.3490E+00	0.	0.	0.	0.	0.	0.
15	16	1	2.4832E+00	0.	0.	0.	0.	0.	0.
16	17	1	2.3011E+00	0.	0.	0.	0.	0.	0.
17	18	1	2.1257E+00	0.	0.	0.	0.	0.	0.
18	19	1	1.8281E+00	0.	0.	0.	0.	0.	0.
19	20	1	1.3304E+00	0.	0.	0.	0.	0.	0.

0 THE NUMBER OF NATURAL FREQUENCIES REQUESTED IS 9

0 THE NUMBER OF NATURAL FREQUENCIES FOUND IS 9

1 GBRP

TEST LONG FREQ, POLAR SEA

NATURAL FREQUENCIES

FREQUENCY 8.41 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG.PART	ABS.VALUE	PHASE ANGLE	REAL PART	IMAG.PART	ABS.VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	9.5793E-01	0.	9.5793E-01	0.	0.	0.	0.	0.
3	9.0203E-01	0.	9.0203E-01	0.	0.	0.	0.	0.
4	8.3507E-01	0.	8.3507E-01	0.	0.	0.	0.	0.
5	7.5919E-01	0.	7.5919E-01	0.	0.	0.	0.	0.
6	6.7515E-01	0.	6.7515E-01	0.	0.	0.	0.	0.
7	5.5472E-01	0.	5.5472E-01	0.	0.	0.	0.	0.
8	4.0091E-01	0.	4.0091E-01	0.	0.	0.	0.	0.
9	2.3203E-01	0.	2.3203E-01	0.	0.	0.	0.	0.
10	6.5125E-02	0.	6.5125E-02	0.	0.	0.	0.	0.
11	-9.1668E-02	0.	9.1668E-02	0.	0.	0.	0.	0.
12	-2.3361E-01	0.	2.3361E-01	0.	0.	0.	0.	0.
13	-3.6697E-01	0.	3.6697E-01	0.	0	0.	0.	0.
14	-4.9019E-01	0.	4.9019E-01	0.	0.	0.	0.	0.
15	-5.8865E-01	0.	5.8865E-01	0.	0.	0.	0.	0.
16	-6.6827E-01	0.	6.6827E-01	0.	0.	0.	0.	0.
17	-7.3643E-01	0.	7.3643E-01	0.	0.	0.	0.	0.
18	-7.9174E-01	0.	7.9174E-01	0.	0.	0.	0.	0.
19	-8.3911E-01	0.	8.3911E-01	0.	0.	0.	0.	0.
20	-8.8340E-01	0.	8.8340E-01	0.	0.	0.	0.	0.

1 GBRP

TEST LONG FREQ, POLAR SEA

NATURAL FREQUENCIES

FREQUENCY 16.11 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	8.4568E-01	0.	8.4568E-01	0.	0.	0.	0.	0.
3	6.5407E-01	0.	6.5407E-01	0.	0.	0.	0.	0.
4	4.4595E-01	0.	4.4595E-01	0.	0.	0.	0.	0.
5	2.3804E-01	0.	2.3804E-01	0.	0.	0.	0.	0.
6	2.9642E-02	0.	2.9642E-02	0.	0.	0.	0.	0.
7	-1.9980E-01	0.	1.9980E-01	0.	0.	0.	0.	0.
8	-4.1555E-01	0.	4.1555E-01	0.	0.	0.	0.	0.
9	-5.7467E-01	0.	5.7467E-01	0.	0.	0.	0.	0.
10	-6.5197E-01	0.	6.5197E-01	0.	0.	0.	0.	0.
11	-6.5208E-01	0.	6.5208E-01	0.	0.	0.	0.	0.
12	-5.5416E-01	0.	5.5416E-01	0.	0.	0.	0.	0.
13	-4.0213E-01	0.	4.0213E-01	0.	0.	0.	0.	0.
14	-2.1081E-01	0.	2.1081E-01	0.	0.	0.	0.	0.
15	-2.1034E-02	0.	2.1034E-02	0.	0.	0.	0.	0.
16	1.6026E-01	0.	1.6026E-01	0.	0.	0.	0.	0.
17	3.4028E-01	0.	3.4028E-01	0.	0.	0.	0.	0.
18	5.0383E-01	0.	5.0383E-01	0.	0.	0.	0.	0.
19	6.5446E-01	0.	6.5446E-01	0.	0.	0.	0.	0.
20	8.0196E-01	0.	8.0196E-01	0.	0.	0.	0.	0.

1 GBRP

TEST LONG FREQ, POLAR SEA

NATURAL FREQUENCIES

NATURAL FREQUENCIES

FREQUENCY 22.60 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	6.9610E-01	0.	6.9610E-01	0.	0.	0.	0.	0.
3	3.5399E-01	0.	3.5399E-01	0.	0.	0.	0.	0.
4	3.5762E-02	0.	3.5762E-02	0.	0.	0.	0.	0.
5	-2.1690E-01	0.	2.1690E-01	0.	0.	0.	0.	0.
6	-4.2249E-01	0.	4.2249E-01	0.	0.	0.	0.	0.
7	-5.0923E-01	0.	5.0923E-01	0.	0.	0.	0.	0.
8	-4.4393E-01	0.	4.4393E-01	0.	0.	0.	0.	0.
9	-2.5903E-01	0.	2.5903E-01	0.	0.	0.	0.	0.
10	-2.0723E-02	0.	2.0723E-02	0.	0.	0.	0.	0.
11	2.0485E-01	0.	2.0485E-01	0.	0.	0.	0.	0.
12	3.5381E-01	0.	3.5381E-01	0.	0.	0.	0.	0.
13	4.3056E-01	0.	4.3056E-01	0.	0.	0.	0.	0.
14	4.2359E-01	0.	4.2359E-01	0.	0.	0.	0.	0.
15	3.4376E-01	0.	3.4376E-01	0.	0.	0.	0.	0.
16	2.1124E-01	0.	2.1124E-01	0.	0.	0.	0.	0.
17	2.7657E-02	0.	2.7657E-02	0.	0.	0.	0.	0.
18	-1.7608E-01	0.	1.7608E-01	0.	0.	0.	0.	0.
19	-3.8577E-01	0.	3.8577E-01	0.	0.	0.	0.	0.
20	-6.0484E-01	0.	6.0484E-01	0.	0.	0.	0.	0.

1 GBRP

TEST LONG FREQ, POLAR SEA

FREQUENCY 28.60 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	5.1351E-01	0.	5.1351E-01	0.	0.	0.	0.	0.
3	3.4739E-02	0.	3.4739E-02	0.	0.	0.	0.	0.
4	-3.1243E-01	0.	3.1243E-01	0.	0.	0.	0.	0.
5	-4.7478E-01	0.	4.7478E-01	0.	0.	0.	0.	0.
6	-5.2556E-01	0.	5.2556E-01	0.	0.	0.	0.	0.
7	-3.1173E-01	0.	3.1173E-01	0.	0.	0.	0.	0.
8	7.4474E-02	0.	7.4474E-02	0.	0.	0.	0.	0.
9	4.2892E-01	0.	4.2892E-01	0.	0.	0.	0.	0.
10	5.9201E-01	0.	5.9201E-01	0.	0.	0.	0.	0.
11	5.3834E-01	0.	5.3834E-01	0.	0.	0.	0.	0.
12	2.3336E-01	0.	2.3336E-01	0.	0.	0.	0.	0.
13	-1.4077E-01	0.	1.4077E-01	0.	0.	0.	0.	0.
14	-4.7036E-01	0.	4.7036E-01	0.	0.	0.	0.	0.
15	-6.3442E-01	0.	6.3442E-01	0.	0.	0.	0.	0.
16	-6.2122E-01	0.	6.2122E-01	0.	0.	0.	0.	0.
17	-4.1597E-01	0.	4.1597E-01	0.	0.	0.	0.	0.
18	-7.3113E-02	0.	7.3113E-02	0.	0.	0.	0.	0.
19	3.4364E-01	0.	3.4364E-01	0.	0.	0.	0.	0.
20	8.1783E-01	0.	8.1783E-01	0.	0.	0.	0.	0.

1 GBRP

TEST LONG FREQ, POLAR SEA

NATURAL FREQUENCIES

NATURAL FREQUENCIES

FREQUENCY 35.82 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	2.3665E-01	0.	2.3665E-01	0.	0.	0.	0.	0.
3	-3.5072E-01	0.	3.5072E-01	0.	0.	0.	0.	0.
4	-5.6471E-01	0.	5.6471E-01	0.	0.	0.	0.	0.
5	-4.3152E-01	0.	4.3152E-01	0.	0.	0.	0.	0.
6	-1.6613E-01	0.	1.6613E-01	0.	0.	0.	0.	0.
7	2.5315E-01	0.	2.5315E-01	0.	0.	0.	0.	0.
8	5.0690E-01	0.	5.0690E-01	0.	0.	0.	0.	0.
9	4.1801E-01	0.	4.1801E-01	0.	0.	0.	0.	0.
10	7.3698E-02	0.	7.3698E-02	0.	0.	0.	0.	0.
11	-2.8577E-01	0.	2.8577E-01	0.	0.	0.	0.	0.
12	-4.0730E-01	0.	4.0730E-01	0.	0.	0.	0.	0.
13	-3.2478E-01	0.	3.2478E-01	0.	0.	0.	0.	0.
14	-8.4116E-02	0.	8.4116E-02	0.	0.	0.	0.	0.
15	1.6791E-01	0.	1.6791E-01	0.	0.	0.	0.	0.
16	3.3638E-01	0.	3.3638E-01	0.	0.	0.	0.	0.
17	3.5591E-01	0.	3.5591E-01	0.	0.	0.	0.	0.
18	2.1505E-01	0.	2.1505E-01	0.	0.	0.	0.	0.
19	-3.2257E-02	0.	3.2257E-02	0.	0.	0.	0.	0.
20	-3.5757E-01	0.	3.5757E-01	0.	0.	0.	0.	0.

1 GBRF

TEST LONG FREQ, POLAR SEA

FREQUENCY 42.07 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	-5.2673E-02	0.	5.2673E-02	0.	0.	0.	0.	0.
3	-6.2652E-01	0.	6.2652E-01	0.	0.	0.	0.	0.
4	-5.4321E-01	0.	5.4321E-01	0.	0.	0.	0.	0.
5	-8.3674E-02	0.	8.3674E-02	0.	0.	0.	0.	0.
6	3.7990E-01	0.	3.7990E-01	0.	0.	0.	0.	0.
7	4.5955E-01	0.	4.5955E-01	0.	0.	0.	0.	0.
8	4.8938E-02	0.	4.8938E-02	0.	0.	0.	0.	0.
9	-4.0769E-01	0.	4.0769E-01	0.	0.	0.	0.	0.
10	-4.8681E-01	0.	4.8681E-01	0.	0.	0.	0.	0.
11	-1.9551E-01	0.	1.9551E-01	0.	0.	0.	0.	0.
12	2.7565E-01	0.	2.7565E-01	0.	0.	0.	0.	0.
13	5.5088E-01	0.	5.5088E-01	0.	0.	0.	0.	0.
14	4.5522E-01	0.	4.5522E-01	0.	0.	0.	0.	0.
15	9.5667E-02	0.	9.5667E-02	0.	0.	0.	0.	0.
16	-2.9941E-01	0.	2.9941E-01	0.	0.	0.	0.	0.
17	-5.2657E-01	0.	5.2657E-01	0.	0.	0.	0.	0.
18	-4.4194E-01	0.	4.4194E-01	0.	0.	0.	0.	0.
19	-1.0688E-01	0.	1.0688E-01	0.	0.	0.	0.	0.
20	4.1978E-01	0.	4.1978E-01	0.	0.	0.	0.	0.

1 GBRP

TEST LONG FREQ, POLAR SEA

NATURAL FREQUENCIES

TEST LONG FREQ, POLAR SEA

NATURAL FREQUENCIES

FREQUENCY 47.82 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	-3.6036E-01	0.	3.6036E-01	0.	0.	0.	0.	0.
3	-7.7740E-01	0.	7.7740E-01	0.	0.	0.	0.	0.
4	-2.9203E-01	0.	2.9203E-01	0.	0.	0.	0.	0.
5	3.5654E-01	0.	3.5654E-01	0.	0.	0.	0.	0.
6	7.4810E-01	0.	7.4810E-01	0.	0.	0.	0.	0.
7	1.0121E-01	0.	1.0121E-01	0.	0.	0.	0.	0.
8	-7.3759E-01	0.	7.3759E-01	0.	0.	0.	0.	0.
9	-6.8806E-01	0.	6.8806E-01	0.	0.	0.	0.	0.
10	1.2319E-01	0.	1.2319E-01	0.	0.	0.	0.	0.
11	7.5656E-01	0.	7.5656E-01	0.	0.	0.	0.	0.
12	3.4253E-01	0.	3.4253E-01	0.	0.	0.	0.	0.
13	-3.6814E-01	0.	3.6814E-01	0.	0.	0.	0.	0.
14	-7.5750E-01	0.	7.5750E-01	0.	0.	0.	0.	0.
15	-5.1671E-01	0.	5.1671E-01	0.	0.	0.	0.	0.
16	9.4601E-02	0.	9.4601E-02	0.	0.	0.	0.	0.
17	6.7298E-01	0.	6.7298E-01	0.	0.	0.	0.	0.
18	7.5317E-01	0.	7.5317E-01	0.	0.	0.	0.	0.
19	3.2520E-01	0.	3.2520E-01	0.	0.	0.	0.	0.
20	-5.2341E-01	0.	5.2341E-01	0.	0.	0.	0.	0.

1 GBRP

TEST LONG FREQ, POLAR SEA

NATURAL FREQUENCIES

FREQUENCY 60.52 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	-1.1783E+00	0.	1.1783E+00	0.	0.	0.	0.	0.
3	-4.6459E-01	0.	4.6459E-01	0.	0.	0.	0.	0.
4	7.7797E-01	0.	7.7797E-01	0.	0.	0.	0.	0.
5	5.6349E-01	0.	5.6349E-01	0.	0.	0.	0.	0.
6	-1.6439E-01	0.	1.6439E-01	0.	0.	0.	0.	0.
7	-5.7286E-01	0.	5.7286E-01	0.	0.	0.	0.	0.
8	2.6743E-01	0.	2.6743E-01	0.	0.	0.	0.	0.
9	5.9229E-01	0.	5.9229E-01	0.	0.	0.	0.	0.
10	-1.5599E-01	0.	1.5599E-01	0.	0.	0.	0.	0.
11	-6.0837E-01	0.	6.0837E-01	0.	0.	0.	0.	0.
12	2.6221E-01	0.	2.6221E-01	0.	0.	0.	0.	0.
13	7.4799E-01	0.	7.4799E-01	0.	0.	0.	0.	0.
14	1.9228E-01	0.	1.9228E-01	0.	0.	0.	0.	0.
15	-5.4438E-01	0.	5.4438E-01	0.	0.	0.	0.	0.
16	-5.9419E-01	0.	5.9419E-01	0.	0.	0.	0.	0.
17	1.7005E-01	0.	1.7005E-01	0.	0.	0.	0.	0.
18	7.7647E-01	0.	7.7647E-01	0.	0.	0.	0.	0.
19	6.2116E-01	0.	6.2116E-01	0.	0.	0.	0.	0.
20	-3.8915E-01	0.	3.8915E-01	0.	0.	0.	0.	0.

NATURAL FREQUENCIES

FREQUENCY 56.01 CPS

STATION	DEFLECTIONS				MOMENT			
	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE	REAL PART	IMAG PART	ABS VALUE	PHASE ANGLE
1	1.0000E+00	0.	1.0000E+00	0.	0.	0.	0.	0.
2	-8.6592E-01	0.	8.6592E-01	0.	0.	0.	0.	0.
3	-7.0652E-01	0.	7.0652E-01	0.	0.	0.	0.	0.
4	3.7348E-01	0.	3.7348E-01	0.	0.	0.	0.	0.
5	7.2363E-01	0.	7.2363E-01	0.	0.	0.	0.	0.
6	4.6576E-01	0.	4.6576E-01	0.	0.	0.	0.	0.
7	-7.2508E-01	0.	7.2508E-01	0.	0.	0.	0.	0.
8	-6.2053E-01	0.	6.2053E-01	0.	0.	0.	0.	0.
9	5.1006E-01	0.	5.1006E-01	0.	0.	0.	0.	0.
10	7.9652E-01	0.	7.9652E-01	0.	0.	0.	0.	0.
11	4.5539E-03	0.	4.5539E-03	0.	0.	0.	0.	0.
12	-7.3963E-01	0.	7.3963E-01	0.	0.	0.	0.	0.
13	-5.7493E-01	0.	5.7493E-01	0.	0.	0.	0.	0.
14	2.7445E-01	0.	2.7445E-01	0.	0.	0.	0.	0.
15	7.4161E-01	0.	7.4161E-01	0.	0.	0.	0.	0.
16	4.2848E-01	0.	4.2848E-01	0.	0.	0.	0.	0.
17	-4.1472E-01	0.	4.1472E-01	0.	0.	0.	0.	0.
18	-8.6606E-01	0.	8.6606E-01	0.	0.	0.	0.	0.
19	-5.6879E-01	0.	5.6879E-01	0.	0.	0.	0.	0.
20	4.6475E-01	0.	4.6475E-01	0.	0.	0.	0.	0.

1 GBRP

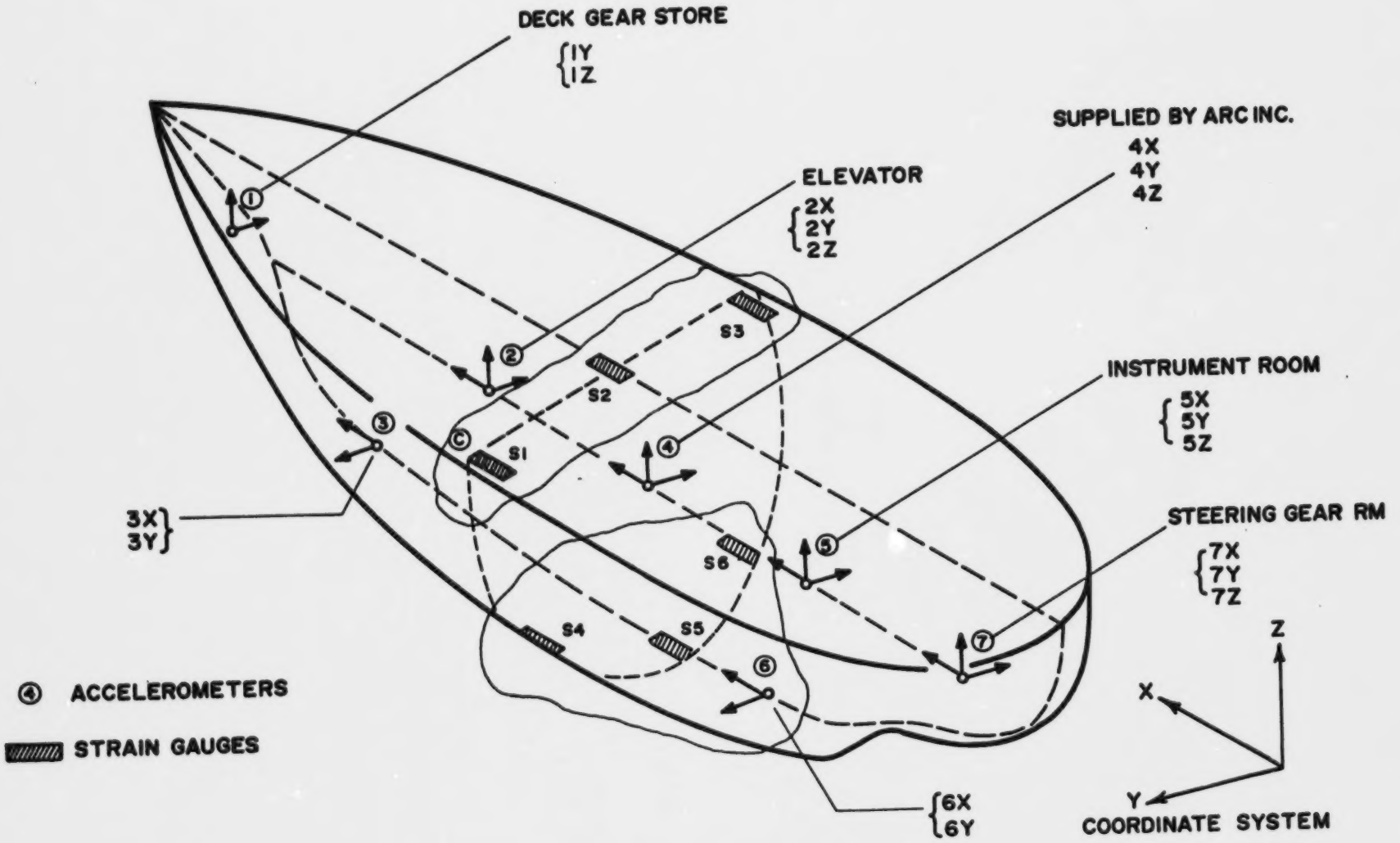
TEST LONG FREQ, POLAR SEA

ANNEX 3

ARCTEC CANADA SHIPBOARD TRIALS LOG

SECTION 1

APPROXIMATE TRANSDUCER LOCATIONS



SECTION 2

1981

TAPE LOG #1

SYSTRON DONNER		RECORDER 1		RECORDER 2		VTR 1		VTR 2		ACTIVITY
DAY	TIME	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	
121		7921-1	0000	7922-1	0000					TEST OUT EQUIPMENT
121	11:50	7921-1	0097							PRETEST ZEROS
	12:03	7921-1	0200							VISHAY ± CALS
	12:26		0230		35					MEASURED MILE # 4 105 RPM 80°
	/1300		460		240					CALM WATER
	/1304		539		320					MEAS. MILE #5 105 RPM 90° PITCH
	1315/1320		593		373					MEAS. MILE #6 105 RPM 90°
			649		421					MEAS. MILE #7 105 RPM 100%
	1600/1616		735		500					MEAS. MILE #8 105 RPM 30%
	1616/		902		670					MEAS. MILE #9 105 RPM 30%
	1632/1635		1050		825					STAR SHAFT T & Q ZEROS
	1635/1637		1075		845					⇐ SHAFT Q & T ZEROS
	1637/		1096		864					PORT SHAFT Q & T ZEROS
	1755/1809		1196		964					130/15% } 4 x NOW FIXED BUFFERING
	1809/1828		1296		1064					130/30% } UNDERWAY
	1828/1847		1460		1230					130/45% }
	1847/1902		1650		1420					130/60%
	2130/2150		1798		1570					10° ROLL UNDERWAY 5Z FIXED
	2225/2227		2030							10° ROLL ACE TEST
122	0802/0830		2200							HEAVY SEAS
	0830/0843		2530		1570					HEAVY SEAS BOTH RECS
	1440/1442		2590		1660					CHANNEL SWAP TEST OK
124	0800/0814		2610					792V-2	000	OPENWATER MOD SEAS
									40	

1981

TAPE LOG #2

SYSTRON DONNER		ACL RECORDER 1		ARC INC RECORDER 2		VTR 1		VTR 2		ACTIVITY
DAY	TIME	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	
1-24	0900/0915	7921-1	2721	7922-1	1660	792V-1	053	792T-1	090	408 TURN TO STARBOARD 60° MODERATE HEAVY SEAS
	1058/1117		2878		1816		095		129	DEISELS ONLY 100% 115 RPM 55 K winds MOD.HEAVY SEA HEAVY LOAD CONDITION
	/1700		3065		2000				171	S1,2,3,4,5,6 EX.5.00 GAIN 5.00
1-25	0912/0929		3590		2525		162		281	MOD.SEAS HULL FLEXING
	/1044		3751		2655		182		289	ZEROS ZERO RPM & PITCH DEAD IN WATER
1-29	1044/		3860		2765				289	105 RPM 100% ALL DIESELS LEFT STANDARD RIGHT STANDARD RUDDER TURN 20°RUDDER
										105 RPM 100% 6 DIESELS
	/1110		4070		2970					105 RPM 100% W 75%¢ CRASH REVERSE
	1110/1122		4111		3018				330	ZEROS B
	1122/1130		4190		3100				348	80° 105 CRASH R.D. #2
	1130/1138		4300		3210				366	60° 105 CRASH R.D. #3
	1138/1145		4374		3280				379	40° 105 CRASH R.D. #4
	1145/1150	7921-1	4434		3340				389	ZEROS C
1-29	1254/1301	7921-2	4495 0000		3394				395	ZEROS D 3° ROLLS STEADY
	1316/		0070		3470				395	¢ & P ON LINE STARBOARD PROBLEMS
	/1402		355		3747				438	CRASH REVERSAL
	1402/1417		453		3847				452	~~60° 160 WINGS 175 ¢ #5~~ CRASH REV 40° 160 WINGS 175 ¢ #6
	1411		513	ABORT	3900				461	20° STARB TRIPED OUT ABORT
			5980		4002	ZEROS				108 HR
			610	FINAL ZEROS					520	ALOFT CON CAL
							580		521	OVER SIDE CAL
							600		538	OVER SIDE ACL CAL
							640			
01-30	2310/2325		610		4002		658		558	LEVEL ICE 12" to 16" 3"SNOW
			738		4136					

TAPE LOG #3

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SYSTRON DONNER		RECORDER 1		RECORDER 2		VTR 1		VTR 2		ACTIVITY
DAY	TIME	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	
01-30	2340/0122	7921-2	738	792-2-7	4136	7923-1	658	7924-1	572	6 DIESELS ON LINE STOPPED IN ICE 130 RPM LEVEL ICE 12" to 16" 3" SNOW 65% BALARD
01-31	0146/0215	7921-2	1385	792-2-2	4600 0000	7923-1		7924-1	619	130 RPM 65% PITCH VARIEN, FAST IN INCE PUSHING FLOE??
	0815/1041		1535		0245				627	W.D.D. & TURBINE
	1041/1300		2900		1610		702	7924-1	824	3' 1-3' SNOW MAX V 7K SEACHEST PROBLEMS
	1300/1458		3400		2000		760	7924-2	000	18" of ICE
	1459/1515	7921-2	4563		3273	7923-1	874		188	RAMMING 18" to 36"
	1515/1502	7921-2	4600	7922-2	3434	7923-2	0000 0000	7924-2	188	RAMMING OPEN & ICE
	1617/1815	7921-3	0000	7922-2	3500	7923-3	0020	7924-2	??	LEADS & SOLID ICE STOP & GO
	1815/	7921-3	1100	7922-2	4600		253		391	STOPPED IN ICE & REC.#2 TAPE CHANGE
	/2106	7921-3	1100	7922-3	0000					SLOW ADVANCE 4' ICE DD/GT/DD
	2106/0900		2085		0992		283		550	OVERNIGHT PROGRESS 108 HR
02-01	0900/1140		2085		0992		382		626	LEADS
			3570		2475		606		810	
	1325/1330		4122		3027		680	7924-2	END	LEAD & FLOES MIXED
	1330/1425		4210		3110		690	7924-2	0000	LEAD & FLOES 1 to 2' THICK
	1425/1444	7921-3	4604	7922-3	3580	7923-2	738	7924-3	115	
	1444/1517	7921-4	0000		3750		743		124	
	1735/1826		0323		4073		779		195	
	1826/2040		0854		4602		850		323	
			0854	7922-4	0005	7923-2	860+		357	ZEROS STOPPED LUBE OIL LEAK
02/02	1110/1230		0971		0123	7923-3	0000 0000		357	LAST LEG TO NOME LARGE LEADS
			1235		0390		089		500	ALOFT CON MARKS
							221		735	OVERSIDE S CALS
							354		750	

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TAPE LOG #4

SYSTRON DONNER		RECORDER 1		RECORDER 2		VTR 1		VTR 2		ACTIVITY
DAY	TIME	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	
02/02	1825/	1-4	1235	2-4		3-3	350	4-3	750	ARCINC THRUST & TORQUE OLD BATTERIES
										ARC INC Q & T NEW BATTERIES
03/02	1420/1430		1235		712	3-3	350	4-3	812	RAMMING
	1430/1440		1280		765		445	4-3	828	TAPE CHANGE REC.#4
	1440/1450		1383		860		531	4-4	000	3' ICE RAMMING GOOD ZEROS FOR Q.T.RPM
	NOTE		1457		933		542		030	~~P & S Q MOVED TO CHANNELS~~ 19,20,21 FROM 1,2,3
	1540/1640		1457		933		542		030	℄ DOWN
	1640/		2058		1534		617		192	GT/DD/GT UNDERWAY IN ICE
	1814/		2217		1835		649		264	GT/GT/GT/ 160,175,160 START ℄ 175,5160 STOPPED CONTROL PROBLEMS PITCH 2HZ VIB
	/2225		2504		2124		681		314	NOTE: AT END OF PERIOD ACL 4XYZ GAIN UP 2.5
	2225/2350		4329		3049		795		473	GT/GT/GT 160/175/160
	2350/2358		4190		3809	3-3	888		582	TAPE 3-3 CHANGE
03/02	2358/0035	1-4	4266	2-4	3884	3-4	000	4-4	593	HIGH SPEED BIDGES & LEADS & FLOWS GT/GT/GT/ 160/175/160
04/02	0035/0044	1-4	4600		4250		109		646	
	0044/0116	1-5	0000		4304		120		652	GT/GT/GT/ 165/176/158
	0120/0127		0304	2-4	4604		189		690	TAPE 792 1-4 CHANGE
	0127/0150	1-5	0304	2-5	0000	3-4	212	4-4	703	DD/GT/DD VIDEO TO ZERO 108Hr END OF 28C REC Q,T,RPM,P, ACC & S
	0925/1109		0391		0090		263		734	DD/DD/DD 130/130/130 LOST ℄ 2 X AT END
	/1144		1357		1056		436		848	2 to 3' ICE SLOW PROGRESS STOPPED SEACHEST ICING
	1217/1553		1676		1374		485	4-4	881	DD/DD/DD RUBBLE 133/130/130
	1553/1747		3581		3274		745	4-5	401	3600-3300 VOICE ICE CONDITIONS
	1747/1757		4638		4337		867		561	
	1757/1815		0000		4420		874		575	
			0185		4600		018		597	

1981

TAPE LOG #5

SYSTRON DONNER		RECORDER 1		RECORDER 2		VTR 1		VTR 2		ACTIVITY
DAY	TIME	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	
04/02	1820					5	000			
02/04	1830			6	0000					
	1840/1900	6	0284	6	0090	5	082	5	627	
	1900/1922	1-6	481	2-6	0286	3-5	132	4-5	652	DEAD IN WATER
02/05	/0054		541		347		147		660	DD/GT/DD 130/175/130 SEACHEST ICE
	0057/0111		747		552		234		710	N/GT/N 0/175/0 0/87/10
	02/0222		828		635		252		721	DD/GT/DD TO ZERO PITCH SEACHEST ICING
	0731/1043		942		750		257		738	DD/GT/DD RAMMING 130/175/130 20/90/31
	1043/1133		1894		1700		438	4-5	856	DD/GT/DD RAMMING 18 HR MODE 130/175/180 RUBBLEFIELD & MILLING
	1209/1220		2356		2162		481	4-6	055	Going astern while stuck in ridge long way on.
	123/		2467		2273		486		064	Backing & ramming at same ridge
	/1258		2688		2494		491		073	DD/GT/DD most noticeable 1300. Torque data questionable.
	/1337		2688		2494		496		081	Change to 3 turbines (2 at 1337)
			2820		2625					1350 backing - 3 turbine GT/GT/GT 1350 pushed into ridge 160/175/160
	1353						498		084	1353 nearly stepped (2 kt) to 18 hr 1359 nearly stepped 1539 start 1405 perceptible vibs 1420 stuck - stopped 1455 stopped - prop vibs 1510 nearly stopped 1512 stopped for inlet
	1512		3587		3391		553		176	Switch to 108 hr.
	1523						554		178	Starting again-center shaft 1527 stopped - log reading 6 kt
	1529	1-6	3645	2-6	3448	3-5	555	4-6	179	Stopped day tank out of fuel
	1615		3700		3504					Zeroes & Cals Q&T
	1620/1630		3700		3646					Underway GT/GT/GT now PQ is ok.
	/1841		4515		4460		599		280	
	1851/1908	1-6	4607	2-6	4560	3-5	600	4-6	292	GT/GT/N
		1-7	0071	2-7	0028		601		303	160/175/0

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TAPE LOG #6

SYSTRON DONNER		RECORDER 1		RECORDER 2		VTR 1		VTR 2		ACTIVITY
DAY	TIME	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	
02/05	1908/1951	1-7	0071	2-7	0028	3-5	601	4-6	303	Leads & Floes 1' Snow GT/GT/N 160/175/0
	1951/2115		475		0421		627		341	GT/GT/GT 166/177/158 35/40/44
	2115/		1258		1203		677		408	GT/GT/GT 166/177/158 29/30/39
	2155	7	1627	7	1572	5	700	6	138	Power balance between shaft adjusted
	2250/2340		2158		2104		732		179	Stopped momentarily & re-started
	2340/0123		2592		2535		737		513	GT/GT/GT 166/177/160 following ridges
02/06	0123/0215		3563		3504		793		582	Lost STBD oil Leak @ 0210 shutdown
	0820/0825		4042		3984		821		614	Zero, T,Q,&
	/1021		4042		4000		821		652	GT/GT/GT 166/177/160 Small floes & Leads
	1049		4302		4264		832		674	Zeroes
			4363		4326		832			Camera Cal 28' Water Line
							847		690	
	1440		4374		4338		847		690	
	1500	1-7	4509	2-7	4608	3-5		4-6		Starting through floe - fast run
02/06	1525	1-8	0006	2-8	0010		847		690	
	1530/1534		0067		0064		847		693	
	1540/		0130		0133		851		698	Back to large lead - STBD shaft down (stopped)
	1854/		0160		164	3-5	866		718	
	/2000		236		240		000		722	
02/07	0032/0048		684		687		074		753	DD/DD/DD 134/131/131 Ramming in Ridge
	0103/0112		811		814		120		774	Stuck in Ridge
			891		895		131		781	
					1					
	0745		0900		0904		134		816	Center shaft gear turbine only Wing shaft locked; pitch 0° - 11% ahead

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TAPE LOG #7

SYSTRON DONNER		RECORDER 1		RECORDER 2		VTR 1		VTR 2		ACTIVITY
DAY	TIME	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	
02-07	1041/0245	1-8	2554	2-8	2555	3-6	308	4-6	817	DD/GT/DD 130/177/130
	1539/1545		3049		3049		358	4-7	087	D/GT/D 130/177/130
	1545		3110		3110		370		117	Ice Edge Impact
	1628/1630		3497		3497		406		164	Zero Vel. Realtime 1 hr. Ice pressure event - 1' thick
	1630/1826	1-8	3535	2-8	3535	3-6	440	4-7	211	DD/GT/DD 127/178/132 Underway 1' & rubble
	1826/1837		4600		4591		543		343	Seachest icing & tape change
	1838/	1-9	0000	2-9	0000					Voice tapes
	1858/1900		0009		0009		547		347	Lost S Shaft
			0024		0024		548		351	
	/1953		0350		0350					DD/GT/DD + 2' 6" - ramming RUBBLE FROZEN GOOD RAMMING
	1953/2037		470		470		569		390	Stuck & Ram
	2039/2113		900		900		599		426	128/178/132; DD/GT/DD
	2113/2202		1215		1215					4' of ice 6" 600' + Ramming
	2207/2335		1724		1724		645		490	139/176/127 DD/GT/DD 4' Ramming
02-07	2335/0000		2501		2497		687		548	2nd of 2 rams hitting side of track with port bow (aft of bow) @ 50-100' from end of old track - side rode up and slid along to near end of old slot
	2305									
02-08	0038/0132	1-9	2727	2-9	2727	3-6	700	3-7	563	GT/GT/GT 166/178/160
	0135/0227		3281		3282		703		614	GT/GT/GT 4'-6' snow 167/177/160
			3985		3985		704		707	
	1115/1132		3998		3990		711		755	Baseline-engines shut down, ship parked in ice.
08/02	2100		4166		4156		711		757	CAL Pulses
	2314/2351		4166		4264		711		793	GT/GT/GT Finally Underway
	2351/		4515		4607		732		814	
			4616							

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TAPE LOG #8

SYSTRON DONNER		RECORDER 1		RECORDER 2		VTR 1		VTR 2		ACTIVITY
DAY	TIME	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	
02/09	0019/0117	1-10	0000	2-10	0000	3-6	744	4-7	825	GT/GT/GT 2.5'
	0117/0127	1-10	620		620		788	4-7	865	GT/GT/GT Rubble & Small Floes
	0127/0239		715		714		793	4-8	000	1TO 2.5' ice continuous GT/GT/GT
	0239/0301		1386		1384		831		095	Continuous 1 to 2.5 ft. stopped in ice at end
	0301/0356		1590		1588		842		122	Port Shaft Dropped @ 03.45
	0356/0403		2111		2108	3-6	868		182	Ridge & thin 1.5' ice. Tape Change
	0403/0657		2179		2181	3-7	000		189	
	0657/0802		3591		3591		099		334	Level & Small Ridges GT/GT/GT/160/177/160
Feb.09		1-10	3905	2-10	3905	307	111	4-8	366	Since Start last night all torque thrust zero suspect probably close
	0830/0838		3911 3976		3912 3974		111		370 371	- backed 1 length
	0845/0954		4603						372	
	1045/	1-11	0000	2-11	0000		111		156	New Tape
	/1444 /1059		0167		0167		113		168	Cleared WL Camera and started it 3' ice -ridge at 1050 -rubble 6-8'high
			2272		2264					Tape under top capstan data could be garbage.
	/1545		2456		2449		330		639	Impact @ Lead to Ice Edge 12K
	1610/1615		2837		2830		341		649	Zeros all shafts stopped
	17 /1802		2902		2896		341		653	GT up stopped Can't see. Snow blowing
	/2350		3046		3046		342		671	
Feb.10	0003/0149		3296		3296		378		717	GT/GT/GT Ramming good accelerations 2.5 to 3.5' 6' ridge 12
	0149/0222		4287		4287		459		776	
	0222/0234	1-11	4600	2-11	4600		484		795	Tape Change
	0234/	1-12	0000	2-12	0000	3-7	487	4-8	802	GT/GT/GT/ Level with small ridges continuous
	/0410		0187		0187		498		811	GT/GT/GT/ Small floes and leads Young Ice 1'
	0410/0452		0911 1300		0909 1300		511 578		851 872	

1981 TAPE LOG #9

SYSTRON DONNER		RECORDER 1		RECORDER 2		VTR 1		VTR 2		ACTIVITY
DAY	TIME	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	TAPE #	COUNT	
Feb.10	0452/0502	1-12	1300	2-12	1300	3-7	578	4-8	872	Tape Change
	0502/0558		1400		1400		585		000	GI/GI/GI Young Ice 1' to leads to flows 2" to 3" 160/177/160
	0558/0655		1917		1913		620		077	GI/GI/GI Ramming in Large Ridge 160/177/160 12 knots & 4 rams same spot
	0655/0728		2453		2450		655		144	GI/GI/GI Ramming 16 knots 1200' run 160/177/160 Full ahead noticeable acc
	9728/		2767		2763		676		180	0750-rebound in a narrow lead 0751-significant
	/0945		4056		4050		756		311	Stopped for flight Str. See Note attached
	1040/1050		4117		4111					Run for zero, Centreline OK Wings may be off due to shaft loading
										Near open water
	/1336		"		"					Hull Vibration at lower shaft rpm - thin ice
	1400/1517		4340		4333		862		467	Stopped -in light ice
	1545/		4340		4333	3-7	867		475	Leads and thin ice
	1601/1633	1-12	4372	2-12	4365	3-8	006	4-8	482	Leads and thin ice D/D/D 107/114/107 98/102/102
	1633	1-12	4666	2-12	4658		049		502	Tape Change
		1-13	0000	2-13	0000	3-8		4-8		
			990		990					
	/2149		1128		990					ACC Cal Station 1,2, &3 990-1050
			1178							ACC Cal Station 7 & 5

Some events observed from bridge and aloft conn.

- Bridge 0810 - heavy ice with snow, a few ridges and piles, broken at steady speed, high pitch
  - occasional rams required to get started after stopping at ridge.

0825-30 - heavy bang, perhaps from ice fracture

0918 - stbd side fwd (below bridge) impact with thick floe at 50' diam, free floating in fork where track crossed a lead at 90°

0930-0940 - 3 cps (app) vibration - remarkably heavy as perceived in aloft conn - ship was in open lead, then turned into light 3" to 12" re-frozen area; low pitch or no pitch, coming to rest in the ice for flying station.

SECTION 3

CHANNEL ASSIGNMENT LOG

FROM Feb 03/81 TO Feb 81

TAPE NO. 7921-4 FROM COUNTER 1457 TO ____

792 - C

FROM Feb 03/81 TO ____

TAPE NO. 2-4 FROM COUNTER 933 TO ____

RECORDER 1

CHANNEL	PARAMETER	ATTENUATOR 1	ATTENUATOR
1	S1 EX 5.0 Gain 5.0 x 2		
2	S2 " "		
3	S3 " "		
4	S4 EX 5.0 Gain 10.0 x 2		
5	S5 " "		
6	S6 " "		
7	1Y		
8	IRIG		
9	1Z		
10	2X		
11	2Y		
12	2Z		
13	3X		
14	3Y		
15	~~FAST TIME CODE~~ 4X		
16	~~SLOW TIME CODE~~ VOICE		
17	4Y		
18	4Z		
19	5X		
20	5Y		
21	5Z		
22	6X		
23	6Y		
24	FAST CODE		
25	7X		
26	7Y		
27	7Z		
28	SLOW CODE		

RECORDER 2

CHANNEL	PARAMETER	ATTENUATOR 1	ATTENUATOR
1	—		
2	-		
3	-		
4	Port Thurst P.T.		
5	C Thrust S.T. } Thrust		
6	Stbd T S.T.		
7	Vessel Speed Arc Inc Moved at 2.6		
8	IRIG 1800 03 FEB		
9	RPM PORT		
10	RPM C } RPM		
11	RPM STBD		
12	PITCH PORT		
13	PITCH C } PITCH		
14	PITCH STBD		
15	~~FAST TIME CODE~~ 4X		
16	~~SLOW TIME CODE~~ VOICE		
17	4Y		
18	4Z		
19	TORQUE PORT		
20	TORQUE C } TORQUE		
21	TORQUE STBD		
22			
23			
24	FAST CODE		
25			
26	VEL		
27			
28	SLOW CODE		

CHANNEL ASSIGNMENT LOG

792-C

FROM 19/01/81 TO Feb. 03/81

TAPE NO. 7921-1 / 7921-4 FROM COUNTER 0000 TO 1457

RECORDER 1

CHANNEL	PARAMETER	ATTENUATOR 1	
1	S1		
2	S2		
3	S3		
4	S4		
5	S5		
6	S6		
7	1Y		
8	IRIG IRA		
9	1Z		
10	2X		
11	2Y		
12	2Z		
13	3X		
14	3Y		
15	~~FAST TIME CODE~~ 4X		
16	~~SLOW TIME CODE~~ VOICE		
17	4Y		
18	4Z		
19	5X		
20	5Y		
21	5Z		
22	6X		
23	6Y		
24	~~SLOW~~ CODE FAST S.C.		
25	7X		
26	7Y		
27	7Z		
28	~~EVENT MARKER~~ SLOW CODE EM		

FROM 19/01/81 TO Feb.03/81

TAPE NO. 7922-1 / 7922-4 FROM COUNTER 0000 TO 933

RECORDER 2

CHANNEL	PARAMETER	ATTENUATOR 1	
1	PORT TORQUE PQ	A	
2	[illegible] TORQUE [illegible]	B	
3	STARBOARD TOR · SQ	C	
4	PORT THRUST PT	D	
5	[illegible] THRUST [illegible]	E	
6	STBD THRUST ST	F	
7	VESSEL SPEED VV	M	
8	IRIG IRB		
9	PORT PROP SPD P.P.S.	G	
10	[illegible] PROP SPD [illegible] P.S.	H	
11	STBD PROP SPD S.P.S.	I	
12	PORT PROP PITCH P.P.P.	J	
13	[illegible] PROP PITCH [illegible] P.P.	K	
14	STBD PROP PITCH S.P.P.	L	
15	~~FAST TIME CODE~~ 4X		
16	~~SLOW TIME CODE~~ VOICE	N	
17	4Y		
18	4Z		
19			
20			
21			
22			
23			
24	~~SLOW~~ CODE FAST S.C.		
25			
26			
27			
28	~~EVENT MARKER~~ SLOW CODE EM	0	

ACCELEROMETER CALIBRATIONS

MAGNETIC RECORDER CHANNEL NUMBER	ACCELEROMETER	VOLTS/g	gs/VOLT
7	1 Y	0.8375	1.1940
9	1 Z	0.8000	1.2500
10	2 X	0.8500	1.1765
11	2 Y	0.7850	1.2739
12	2 Z	0.8000	1.2500
13	3 X	0.8000	1.2500
14	3 Y	0.8200	1.2195
15	4 X	1.0427	0.95905
17	4 Y	1.0475	0.9547
18	4 Z	1.0413	0.9603
19	5 X	0.8375	1.1940
20	5 Y	0.8150	1.2270
21	5 Z	0.8050	1.2422
22	6 X	0.8400	1.1905
23	6 Y	0.8050	1.2422
25	7 X	0.8450	1.1834
26	7 Y	0.8150	1.2270
27	7 Z	0.8100	1.2345
16	VOICE		
28	TIME - SLOW CODE		

ANNEX 4

VTR-LOG OF SELECTED CASES

(81 POLAR SEA TRIAL)

OPEN-WATER OPERATIONS

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

OPEN WATER

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01/24	09:15	7921-1	N/A						Mod - Heavy Sea Ship Roll up to ±30°	Engine D/D/D RPM 115/115/115 Pitch 100/100/100 %

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

DIESEL CRASH REVERSAL

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01/29	11:07:30 VTR 320	7923-1 7924-1	7921-1	Open Water Sea State 3 Wind 15K Roll of ship ≈± 10° Open Water			≈11.5K			Crash Reversal Engine 2D/2D/2D RPM 105/105/105 Pitch 100%/75/100
	11:09:25 VTR 324									Pitch Reversal e.i. -65%/-65%/-65%
	11:09:39									RPM 0/0/0/ Pitch 0/0/0
	11:10:34						0			
	TAPE COUNT #1 4132 #2 3038									

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01-29	11:18:47 VTR 339 Tape Count #1 4198 #2 3104	7923-1	7921-1	OPEN WATER Sea State 3 Wind ≈15K						Target Crash Reversal Pitch 80/80/80/ Engine 2D/2D/2D RPM 105/105/105
	11:22:35									Lost Center Shaft
	11:23:10									All shafts RPM 105
	11:23:50									Pitch 60%
	11:24:54						≈10K			Pitch 80%
	11:26:57						≈13K ≈11.2K	Wheel-House Control Room		
	11:28:15									Pitch 0%
	11:29:08 VTR 358									Pitch -65%/-60%/-65%

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01-29	11:35:15 VTR 366	7923-1 7924-1		Open Water Sea State 3 Wind 15K			≈9K			Target - Crash Reversal Pitch 60%/60%/60% Engine 2D/2D/2D/ RPM 105/105/105
	11:35:55									Pitch 0/0/0
	11:36:41									Thrust ≈ -150,000 Pitch -60%/-60%/-60%
	11:37:15									Pitch ahead

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01-29	11:42:00 VTR 375 Tape #1 4409 #2 3315	7923-1 7924-1	7921-1 7921-2	Open Water Sea State 3 Wind 15 K			≅7K			Target - crash Reversal Pitch 40%/40%/40% Engine 2D/2D/2D/ RPM 105/105/105 Roll ≅ 10°
	11:42:25									P = 0 Thrust ≅ - 84,000
	11:43:00									Pitch -40%/-40%/-40%
	11:44:10									Pitch 0/0/0

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

GAS TURBINE TEST CRASH REVERSAL

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01/29	13:58:00 VTR 434	7923-1 7924-1	7921-2	Open Water Sea ≅ 1-2ft Wind ≅ Roll ≅± 5°			13.0K		Target: Crash Reversal	Engine GT/GT/GT RPM 160/175/160 Pitch 60%/60%/60% Thrust ≅ 165,000 lb
	14:00:50									Astern
	14:01:14									Pitch 0% Thrust ≅-330,000 lbs.
	14:01:54									Pitch -50%
	14:03:13									Pitch -40%
	14:04:13									Ahead

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

GAS TURBINE TEST

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01-29	14:07:30	7923-1 7924-1	7921-2	Open Water			≈9.5K		Crash Reversal:	Engine: GT/GT/GT/ Pitch: 40%/40%/40% RPM: 160/175/160
	14:08:50									Astern
	14:09:00									Pitch 0%
	14:09:35									Pitch -40%
	14:10:35									End

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

GAS TURBINE TEST (ABORTED)

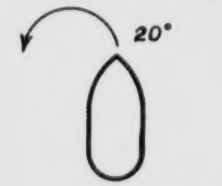
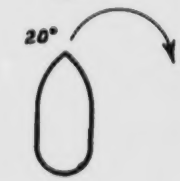
TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
				Open Water			n/a		Crash Reversal:	Engine: GT/GT/GT Pitch: 20%/20%/20% RPM: 160/175/160

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

OPEN WATER TURNING TEST

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01/29	10:50:25 VTR 290	7923-1	7921-1	Open Water Wind 15K Sea State 3			11.5K			Turning Test Engine: 2D/2D/2D RPM 105/105/105 Pitch 100%/100%/100%
	10:55:55 VTR 300			Open Water						
	10:56:59 VTR 303			Open Water Wind 15 K Sea State 3			11.5K			Engine: 2D/2D/2D RPM: 105/105/105 Pitch: 100%/75%/100%
	11:02:34 VTR 312			Open Water					Rudder Shift 10°	
	11:02:37									Center Shaft 80% Pitch due to over heating
	11:03:30 VTR 315									Center Shaft Pitch 0
	11:04:15 VTR 316									

ICEBREAKING SCENARIOS

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

LEVEL ICE

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01/30	23:42:52 VTR 567	7923-1	7921-2	Level Ice Max. Avg. Press Ridge Max. Avg. Floe size medium Snow Cover 4" Ice Concentration 9.5/10 No. of ridge/mile 1	 1.5' 1.0' Sail 1.0' 1.0'		 9.5'/sec	Ctr.		Ship ramming in level ice Engine D/D/D RPM 130/130/130 Pitch 65%/65/65 Continuous motion
	23:45			Stop						Shaft dropped off.

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

LEVEL ICE

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01/30	23:56 VTR 675	7923-1	7921-2	Level Ice Max. Ave. Press ridge Sail Max. Ave. Floe Size Big Snow Cover Ice Concentrate 9.5/10 No. of Ridge/ Mile 6	 1.3' 1.3' 4.' 2.' 3" 		≅2'/sec	Ctr.		Ship slowly proceeding through ice Engine: DD/DD/DD RPM: 130/130/130 Thurst Varied 1° 320,000 lb. 2° 360,000 lb.
	23:59									
01/31	01:17:57 VTR 602	7923-1	7921-2				0	Ctr.		Ship Pushing Pitch Varying RPM 130/130/130 Engine: D/D/D Thrust = 200,000 lb.
	01:18:00									400,000 lb.
	01:18:30									430,000 lb.
	01:19:00									470,000 lb.
	01:20:30									480,000 lb.
	01:21:00									490,000 lb.
	VTR 606									
	End of Tape	#1 Recorder	#2							

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA LEVEL ICE

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01/31	06:10:00 VTR 640	7923-1	7921-2	Level Max. Ave. Press.ridge Sail Max. Ave. Snow Cover Floe Size Giant	 2.5' 2.0' 3.0 1.5 3"		12.0'/sec			Ship in Ramming mode Continuous Engine: D/GT/D RPM: 133/176/130 Pitch: 9/10/9
	06:20									

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

LEVEL ICE

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01/31	07:30 VTR 650	7923-1	7921-2	Level Max. Ave. Press.ridge Sail Max. Ave. Snow Cover Floe Size Big	 3-3.5' 1.5' 4' 2' 2"-3"		7.5K	CTR.		Ship in Ramming Mode Continuous Engine: D/GT/D RPM: 139/176/130 Pitch: 11/11/12
	07:40									

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

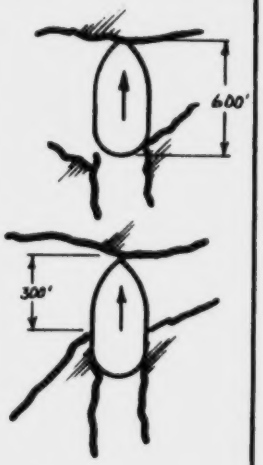
VESSEL: POLAR SEA LEVEL ICE

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01/31	09:07 VTR 712	7923-1	7921-2	Level Max. Ave. Press.ridge Sail Max. Ave. Snow Cover	 3.5' 1.5 3.' 1.0' 2		8.7K	CTR.		Ship Ramming Continuous Mode Engine: D/GT/D RPM: 133/176/130 Pitch: 8/14/9
	09:15:30									

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
							ft/sec			
31/01		7923-1 7924-1								
A)	10:00:06			Level 3' + Snow 1-2'			50/3.5 14.3	Bow Ctr.		
B)	31/01 14:15:36	7923-2 7924-2		Level 18"			100/6.5 15.3	Bow Ctr.		

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA LEVEL ICE

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01/31	20:45 VTR 514 7924-2	7923-2	7921-3	Ice Floes With Rafting Level Ice Max. Ave. Press Ridge Max. Ave. Snow Covered	 4' 3' 3' 1.5' 3"		≈6'/sec	CTR.		Continuous Ramming Engine: D/GT/D RPM: 127/176/130 Pitch: 7/9/7
01/31	21:44 VTR			Ice Floes With Rafting Level Ice Max. Ave. Press.ridge Max. Ave. Snow Cover	 2.5' 2.0' 3' 1.5 4"		≈8.5'/sec			Engine: D/GT/D RPM: 132/170/129 Pitch: 12/12/11

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01/30	23:43	7923-1 7924-1	7921-2	Level			ft/sec Start			
				12"-56"			300/29 200/9 300/21 100/7 300/19			8.9 K 8.0 K
	23:45						Stop			
	23:56			Level			50/22			130 RPM @ 65%
	23:59						100/50			320,000 lb. Thrust
	00:00						Stop			360,000 lb. Thrust
	01:18						0			200,000 lb. Thrust
	01:18:30						0			400,000 lb. Thrust
	01:19						0			430,000 lb. Thrust
	01:20:30						0			470,000 lb. Thrust
	01:21						0			480,000 lb. Thrust
02/02										490,000 lb. Thrust
	14:28	7923-3 7924-3	7921-4	Multi-year Level 1'-2'			500/37			
				Level 1'-2'						
	14:29:50			Multi-year			300/50			
	14:31:00			End of Tape						

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

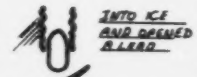
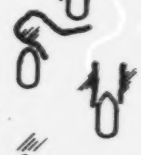
VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	31/01 13:00	7924-2	7921-2	Tape C = 3400			ft/sec			
	13:16:40			18" Level/ Floe			100'/10	Port B/3		
	13:21:48									
	13:22:28						200/26	STBD. B/6		
	13:22:58						200/20			
	14:04:06									
	14:06:41			Level			300/20 200/13			
	14:10:00			Level			300/30			
	14:15:37			Level			200/13	CTR.		
	14:16:			Level			25/60	CTR.		Hit heavy ice ridge which stopped the ship Back ≅ 375' Back ≅ 350' Impact and Ramming
	14:20						50/6	CTR.		
	14:24									
	16:26			18-36" Ice Ridge			100/10	CTR.		
	16:28			Reverse						

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01-31	16:42	7924-2	7921-3	Multi-year			100/25	CTR.		Ramming
	16:48						100/22			
	16:52:01			Multi-year			200/10			Ice edge
	16:53			Level Ice			200/29			Impact
	17:00			Multi-year Level			100/8	CTR.		Ramming
	17:05			Level			100/11			
	17:03:40						200/17			Impact
	17:09:23						100/8			Impact
	17:12:29						100/9			Impact
	17:15:19						100/9			
	17:27:15						100/12			Back and Ramming

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

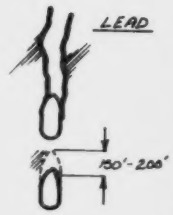
VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
01-31	17:28	7924-2	7921-4	Multi year Floes			100/21			Ramming
	17:38:38			Level			100/7	CTR.		Back
	17:43:34			Large Floe			100/6			Ramming Course altered
	17:44:30			Large Floe			100/10			Ramming Course altered
	19:24:20			4'			200/14			Back and Ramming
	19:33:40			4'			100/7			Back and Ramming

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	03/02 14:41 14:44	7923-3	7921-4	Level 3'			100/26			Ramming
	16:40 16:42			Level			100/12			Ramming
	04/02 09:33:35 09:42 09:51	7923-4	7921-5	Multi-year Floes c/w leads Ice 2-3'			100/11			Ramming 130 RPM 40% Pitch Snow = 12" Ice 1'-2'
	09:51:42			Level			100/9			Ramming and Backing
	10:16:00			Multi-year Floes			150/15			Ramming ≐ 50% pitch
	10:24:00			Rubble field Dirty Ice			100/10			130 RPM
	10:30			Larger Floes			100/5			
	10:46			Stop - Lost Ctr.line shaft.						

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
21-04	16:07	7924-5	7921-6	Floe size medium Snow 8" Lots of rubble and refrozen leads			10/10			SHP ≐ 11775 Ship resistance=207194 lbs V(wind) = 8Kn 80° true RPM - 130 Pitch 9° Thrust - 229169
	16:15			-do-						Backing and Ramming
	16:40			Overheating Center Shaft Zero thrust center shaft						
	16:44			Restoration Center Shaft						
	17:03			Less Rubble			100/9		0	Ramming Lat.66° 29.7'N Long.166° 17.4'W
	17:19:20			Largest Floes			100/14			Ramming
	17:25:30			Leads						
	17:35			Floes						
	17:41			Leads and Rubble						

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	05/02 03:30	7924-5	7921-6	Level			200/20			Ramming
	04:30									
	06:00			Floes and Rubble			200/13			Backing and Ramming
	07:45									
	09:30			Rubbles heavily packed						
	09:45						50/20			Backing and Ramming
	10:09			Medium floes & Rubble			50/32			Ramming
	10:19									

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	05/02	7923-5	7921-6							
	12:45	7924-6		Ridge						Backing and Ramming
	12:48									Pushing
	13:00									Backing and Ramming
	07/02									
	00:36			Ridge Multi-year						Ramming and Backing Reverse Thrust but V = 0
	01:07									

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	07/02	7923-6	7921-9							
	19:40	7924-7		Ice 2-3'+ Snow 6" Some rafting			≅ 0			Ramming and Backing Moderate to heavy vibration (ice pressure)
	20:39						50/20			
	21:50			4' 6" snow			≅ 0			Backing and Ramming
	08/02	7923-7	7921-9							
	00:00			4' ice			50/30			Ramming
	01:20									
	02:27			7' press ridge			≅ 0			Backing and Ramming
	02:36									
	02:40									
	02:47						100/8			Ramming

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	Feb.7 23:34:12	7923-6 7924-7 #557	7921-9 #2468	Ice Ridge Mostly Rubbles Level Ice Max. Ave. Press.ridge Sail Max. Ave. Snow Cover Floe Size Medium	 4.0' 3.0' 4.0' 3.0' 6"		≈9'/sec	Bow Centre		Made a channel Ahead for ram at 23:32:58 Engines: DD/GT/DD RPM: 106/176/103 Pitch: 4/3/3 Broken ice pieces in channel, mostly rubble Moderate impact at 23:34:12 Swayed to port and then starboard, after impact Advanced 500 ft. before coming to a stop.

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	Feb.08 02:06	VTR 665 7923-6	7921-9 #3572	Ridge - mostly rubbles Level Ice Max. Ave. Press. sail Height Max. Ave. Floe Size Small Snow Cover	 4.5' 3.5 7' 4' 9"		≅10'/sec			Ship ramming through ridge Continuous mode Engine: GT/GT/GT RPM: 167/177/159 Pitch: 9/6/7
	02:13			Nothing Exciting			≅ 0			
	02:16:00	VTR 677 7923-6	7921-9 #3666	Ridge, mostly rubbles Level Ice Max. Ave. Press.sail Height Max. Ave. Floe Size Small Snow Cover	 4.5' 3.5' 7' 4' 9"		≅6K	Port Bow		Made a channel & reversed Broken, moderate sized ice pieces in channel Ahead again at 02:15:30 Bow, port side, slide against the ice edge before impact Advanced 200 ft. before coming to a stop.

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	Feb.8 02:23	7923-6	1-9 Count 3732	Level Ice Pressure Ridge Max. Ave.	4' 3.5'		6 K	Oblique		Rammed and Reversed Ahead and reversed before contact with ice edge at 02:30 Rammed into level ice at 6 knots ahead Rammed into and became stuck on a pressure ridge

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	Feb.8 02:30:16	VTR 695 7923-6	Count 3797- 3804 7921-9	Ridge Mostly rubbles Level Ice Max. Ave. Press.Sail Height Max. Ave. Floe Size Small Snow Cover	 4' 3.5' 7' 4' 9"		9K	Sliding on Bow Starboard		Ahead at 02:29:45 Starboard side slid against ice edge to the end of the channel Ship swayed and hit the ice Ramming continued for about 100 ft. before stopping at 02:30:33

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

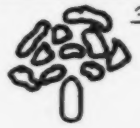
VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	Feb.8 23:50:05	VTR 831 7923-6	Count 4494- end 7921-9	Edge of a Ridge Level Ice Max. Ave. Press.Sail Height Max. Ave.	 2' 1' 6' 3'		≈15'/sec	Port		Rammed level ice ≐ 1'-2' thick, then Hit the edge of a ridge while turning to starboard causing the ship to sway.

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	02/09 01:49 01:58	7923-6 7924-8	7921-10	1-2.5' ice Level and small floes			100/9		 ≃9/10	Ramming
	02:00 03:00						100/8		10/10	
	06:30 06:40						100/9			Ramming
	07:30 07:45						100/7			Ramming
	00:05 01:15						100/7			Backing and Ramming
	01:42						100/8			Ramming
	02/10 02:33:08			Level & Ridge ≈3'			8.4K		≃ 9/10	Ramming
	03:30						100/12			
	04:20						100/7		≃10/10	Ramming

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	2/9 06:09:00	VTR 290 7923-7	Count 3115 7921-10	ICE Pack (Ridge) Level Ice Max. Ave. Press.Sail Height Max. Ave. Snow Cover Floe Size Medium	 4' 3' 6' 4' 6-8"		≅9'/sec			Made a channel and reversed Broken ice in channel; low to moderate coverage ± 9/10 Ahead again at 06:07:57 portside in contact with ice edge Turned and hit the center of the channel's end at ± 06:09

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	02/09 06:20:17	VTR 300 7923-7	Count 3232 7921-10	Ice Ridge C/W Level Ice Max. Ave. Press.Ridge Sail Max. Ave. Snow Cover	 4' 3' 6' 4' 6-8"		≅15'/sec			Made a channel and reversed Broken ice in channel, moderate Ahead again at 06:19:37; port bow at B/3 in contact with ice edge Turned to channel's centre

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	02/09 06:26:00	VTR 306 7923-7	Count 3310 7921-10	Ice Ridge C/W rubbles Level Ice Max. Ave. Press.Sail Height Max. Ave. Snow Cover Floe Size Medium	 4' 3' 6' 4' 6-8"		12'/sec	Star- Board B/2		Made a channel and reversed Broken ice in channel, moderate Ahead again at 06:27:51; port side at B/2 in contact with ice edge Turned to starboard Impact, at end of channel, on bow starboard side

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	Feb.9 09:57:00	VTR 432 7923-7	N/A	Rubbles Level Ice Max. Ave. Press.Ridge Sail Max. Ave. Floe Size Medium In Open Channel after Break up. Broken ice pieces Concentration 9/10"	 4' 2' 4' 2'		1° ≅11'/sec 2° ≅15'/sec 3° ≅7'/sec	Bow Center		Backing and Ramming ahead at 09:57:00 Impact @ 09:57:53 Stop @ 09:58:04 Back @ 10:01:46 Impact @ 10:02:25 Stop @ 10:04:06 Back @ 10:05:48 Impact @ 10:16:15

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	Feb.9 13:50:40	VTR 583 7923-7	7921-11 #1748	Level Ice Max. Ave. No Press. Ridge Snow Cover	 3' 2' 10"		 20'/sec			Made a channel and reversed Channel fairly clear Ahead again at 13:49:50 Struck broken ice before impact Impact at B/2 on starboard side Ice cracked on portside ≐ B/3 at 13:51:97 Outer ice piece moved away rapidly Continued ramming in level ice

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

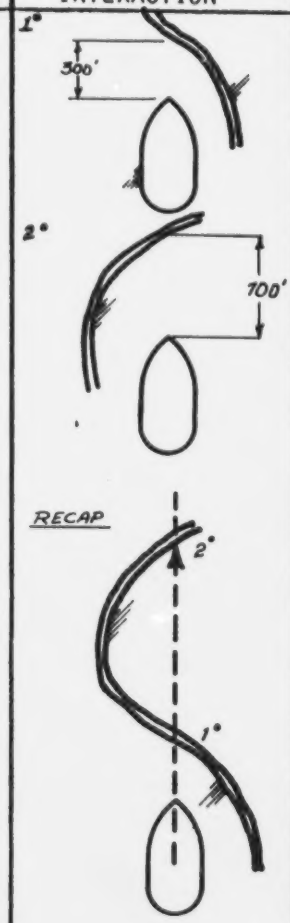
VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	Feb. 9 14:00:12	VTR 589 7923-7	Count 1833- 1864 7921-11	Level to Ice Ridge Level Max. Ave. Snow Cover Ridge Max. Ave. Press. Ridge Sail Height Max. Ave. Snow Cover	 3' 2' 10" 3' 3' 4' 3' 8"					Ship in ramming mode Hit heavier ice (ice edge) at ≐ 14:00:12 causing ship to slow down and sway to port Ship stopped at 14:04:10

ARCTEC CANADA LIMITED

TABLE - VTR TAPE LOG OF SELECTED CASES

VESSEL: POLAR SEA

TEST NO.	TIME OF IMPACT	TAPE		ICE			IMPACT		SKETCH OF IMPACT INTERACTION	COMMENTS
		VIDEO	MAG.	TYPE	THK	STRENGTH	SPEED	POS.		
	Feb.9 13:57:47	VTR 587 7923-7	Count 1817- 1821 7921-11	Level Ice Max. Ave.	3' 2'		20'/sec			Rammed level ice Passed over crack at 13:50:48 At 13:57:47 ice appeared thicker At ≐ 13:58:12 ice on port side caused ship to sway

ANNEX 5

ACCELERATION PROFILES

TIME SERIES SHOWN REPRESENT LENGTH OF REDUCED DATA
ACCELERATION PROFILES PLOTTED AT 1Y AND 2Z
ALL ACCELERATIONS IN G's
SCALE FOR ACCELERATION PROFILES 1 DIVISION = 0.2G
HORIZONTAL ACCELERATION PROFILES ON LEFT
VERTICAL ACCELERATION PROFILES ON RIGHT

ARCTEC CANADA
PLT464 - GRAPHICS

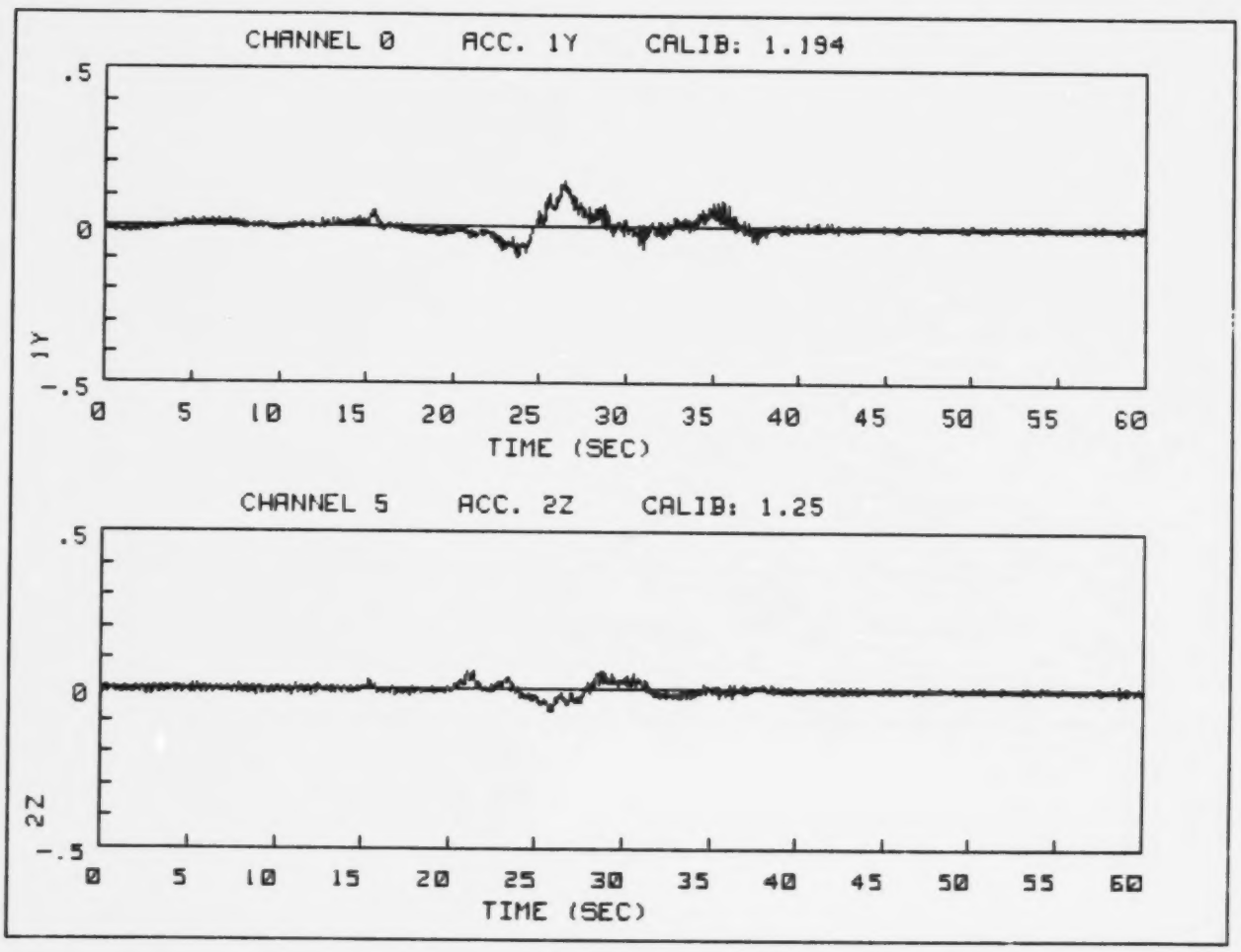
USCGC POLAR SEA -F.S. TEST RAMMING LEVEL ICE

TEST CODE=F8-1 TEST DATE=FEB 8 1981 (02:30)

ICE TYPE=LEVEL ICE COVERAGE=100 % THICKNESS=3.5′ avg.

DIGITIZED DATE=09:04:12:57:11

PLOT STEP SIZE= 1



ARCTEC CANADA
PLT464 - GRAPHICS

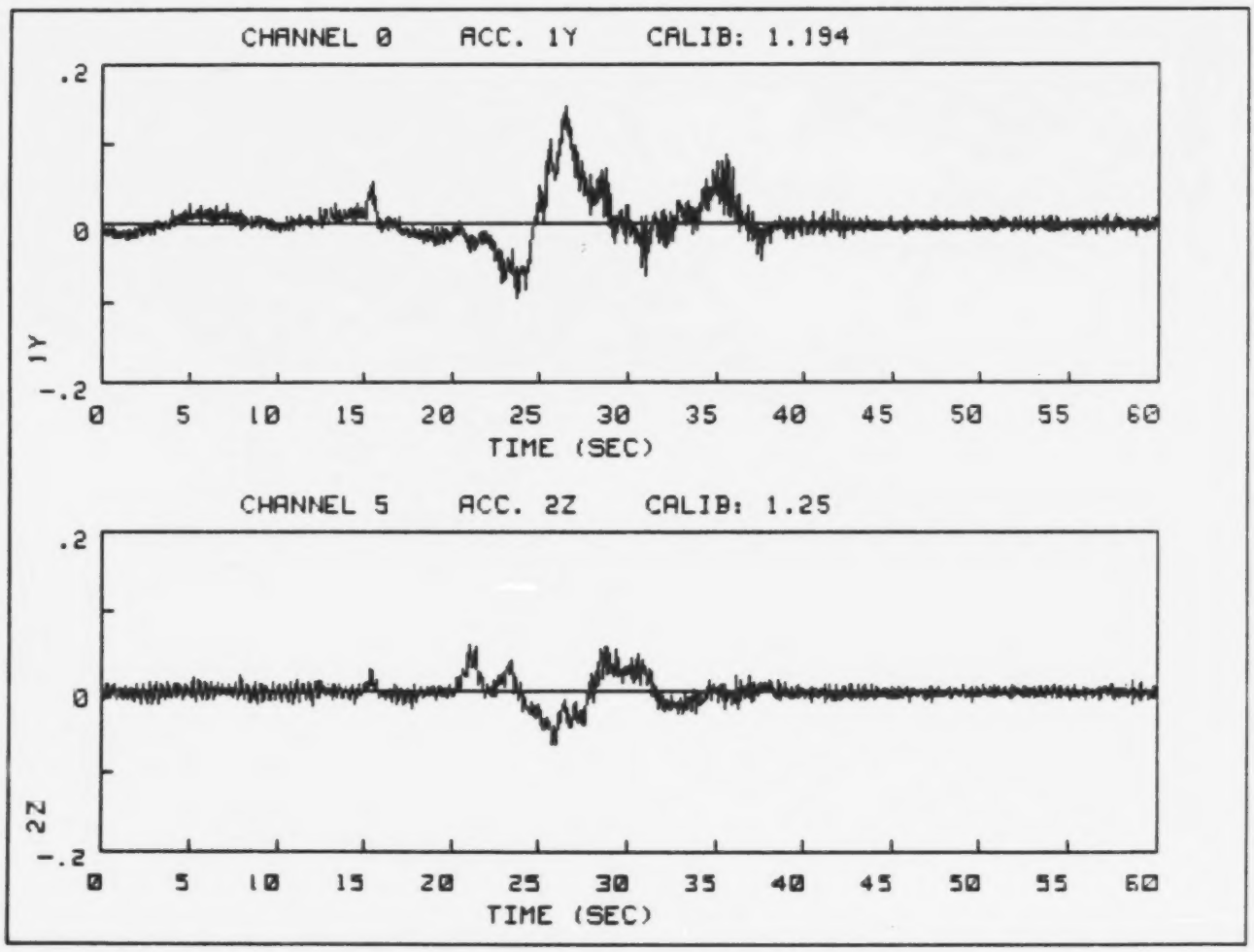
USCGC POLAR SEA -F.S. TEST RAMMING LEVEL ICE

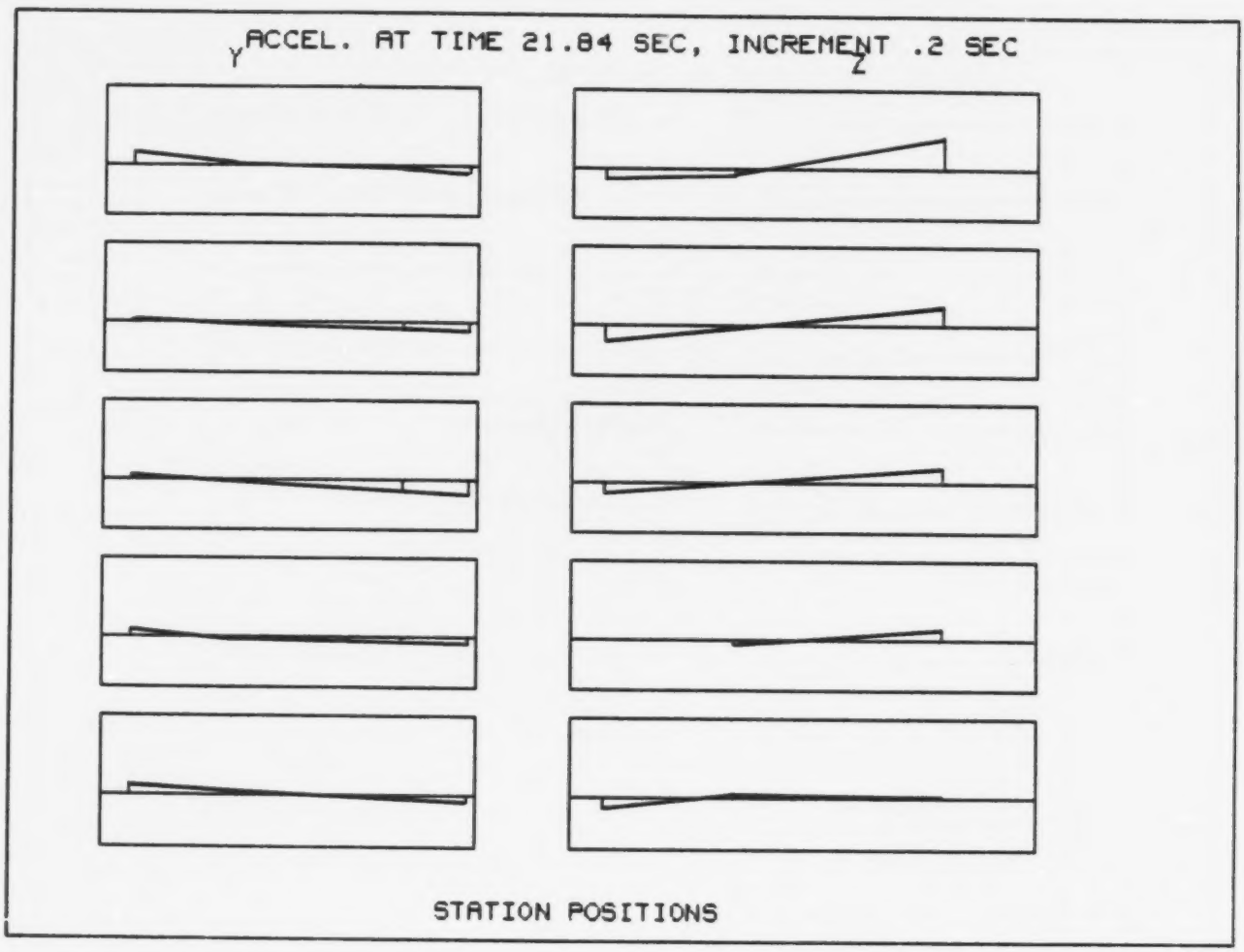
TEST CODE=F8-1 TEST DATE=FEB 8 1981 (02:30)

ICE TYPE=LEVEL ICE COVERAGE=100 % THICKNESS=3.5′ avg.

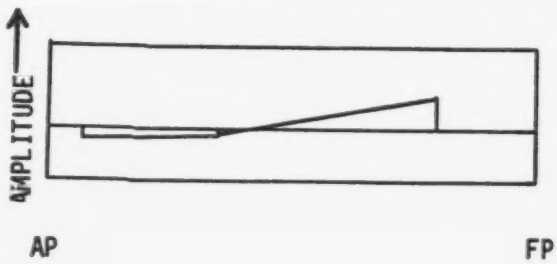
DIGITIZED DATE=09:04:12:57:11

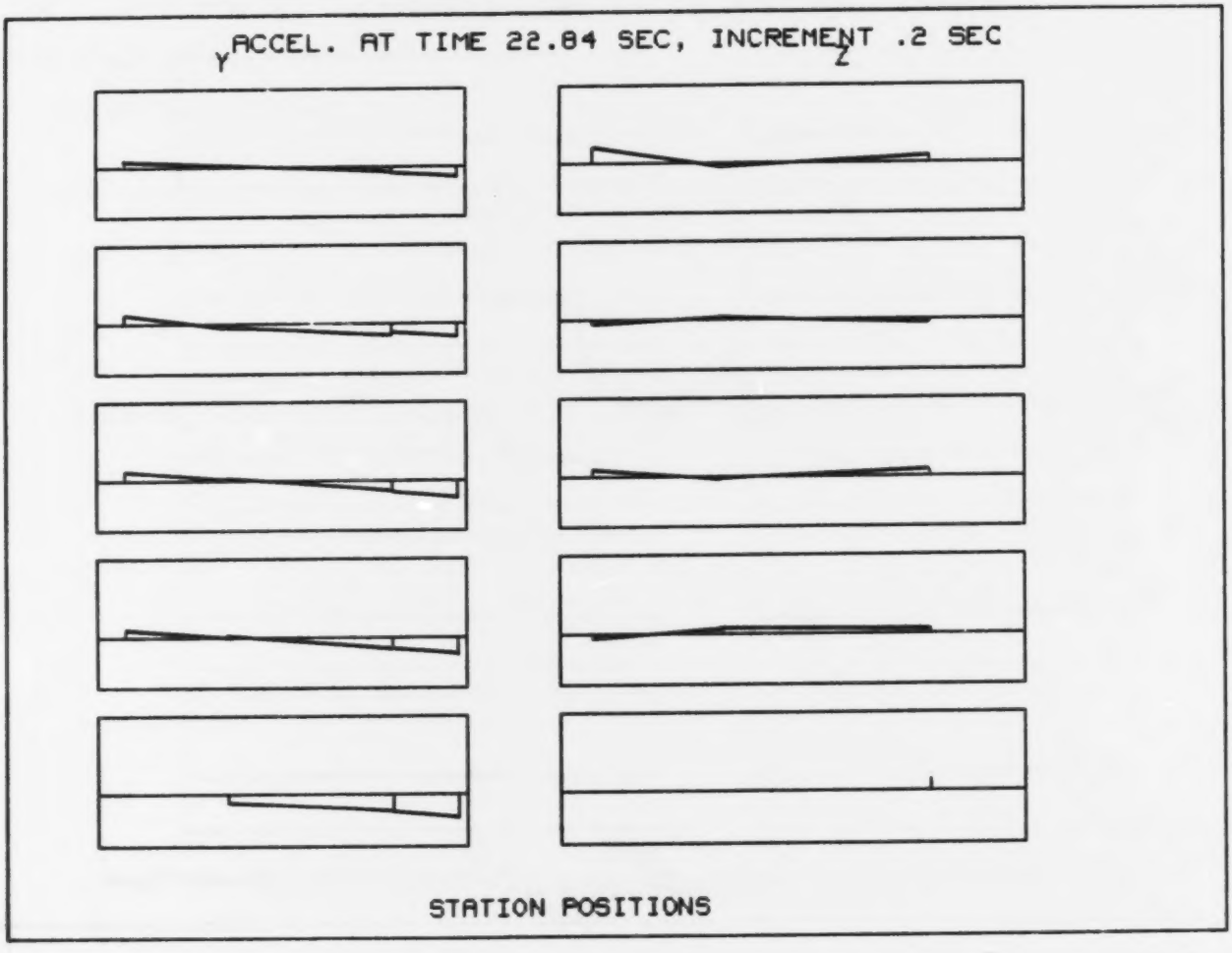
PLOT STEP SIZE= 1




Y ACCEL. AT TIME 21.84 SEC, INCREMENT .2 SEC Z
STATION POSITIONS

LEGEND:


AMPLITUDE
AP
FP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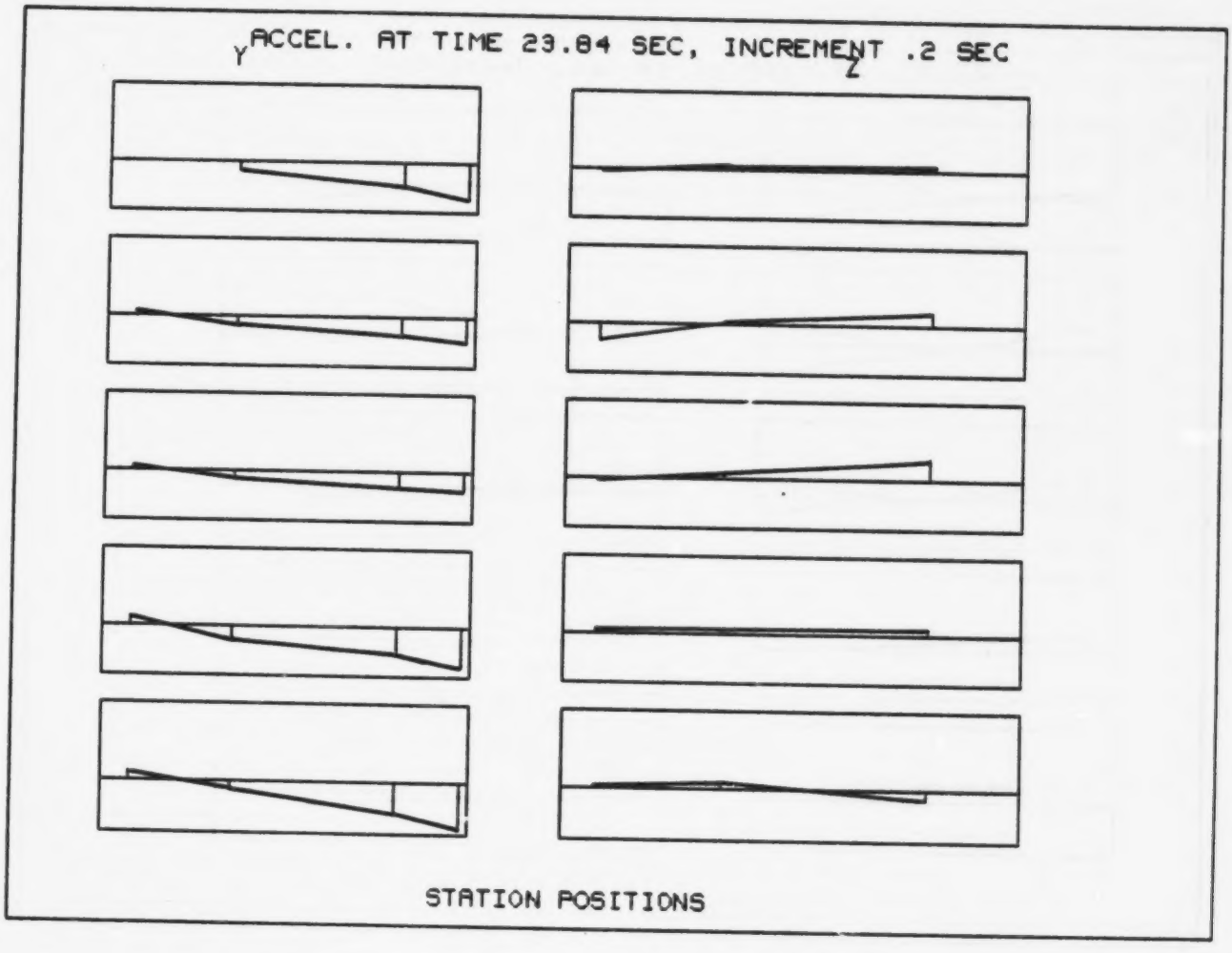
STATION POSITIONS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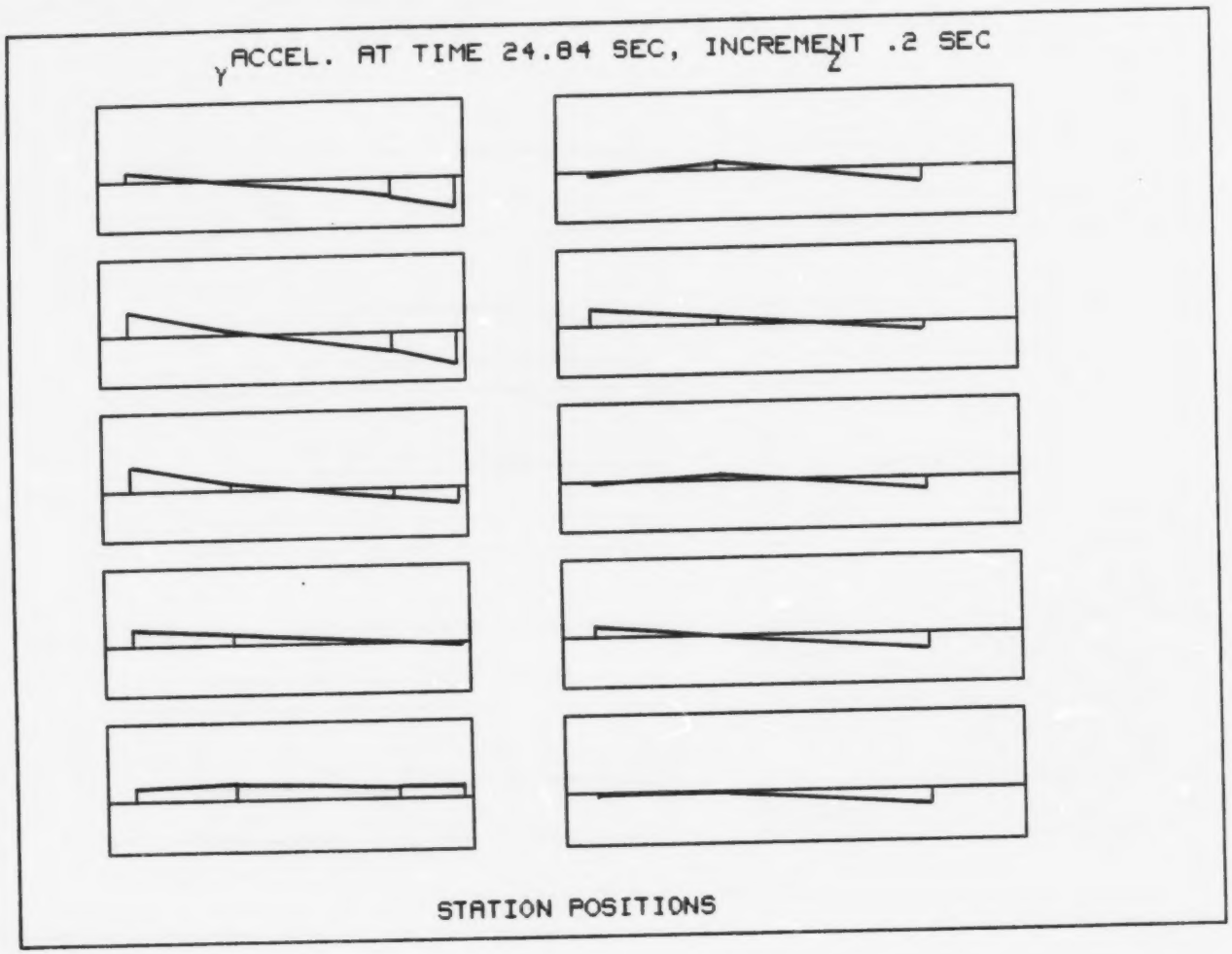
STATION POSITIONS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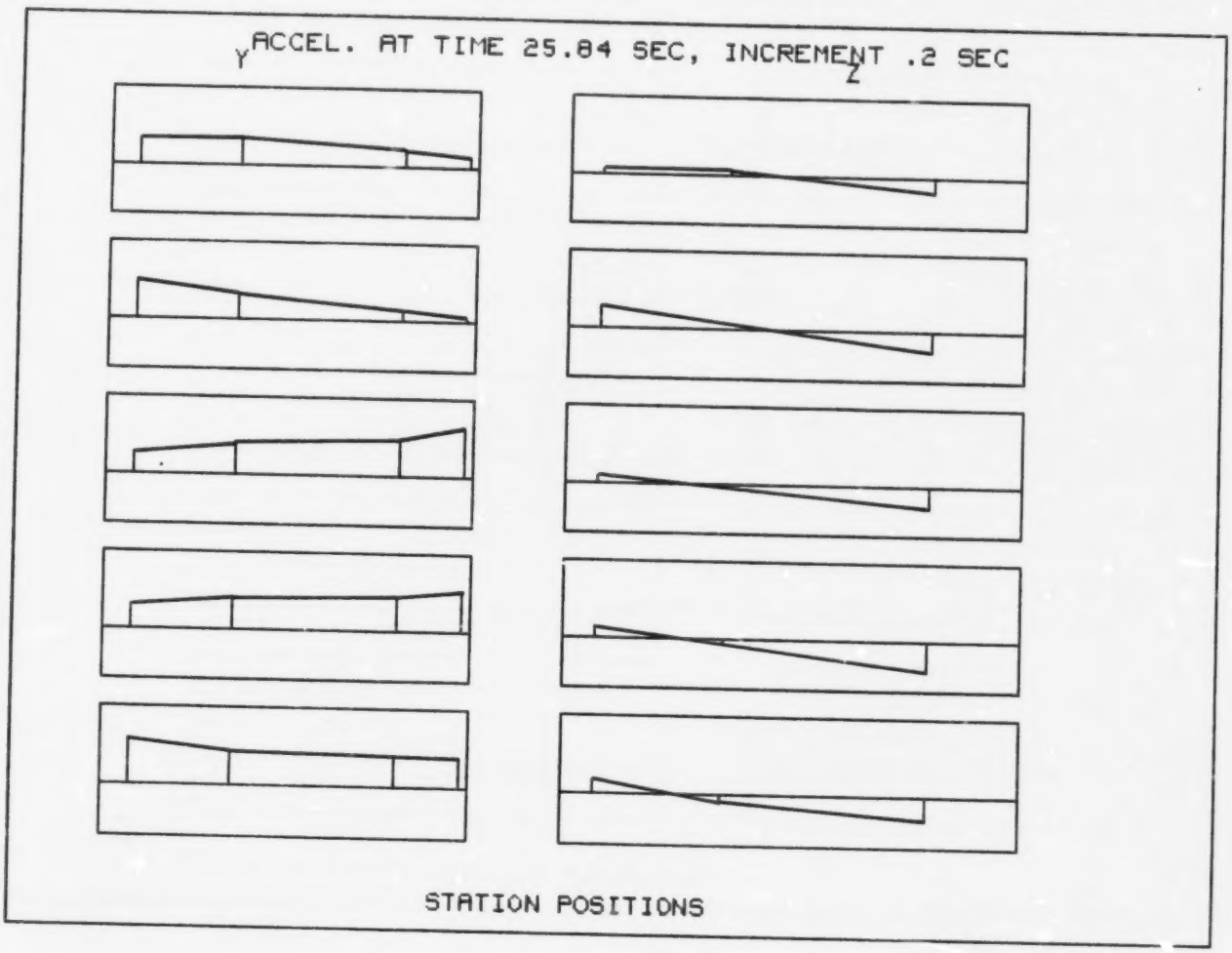
STATION POSITIONS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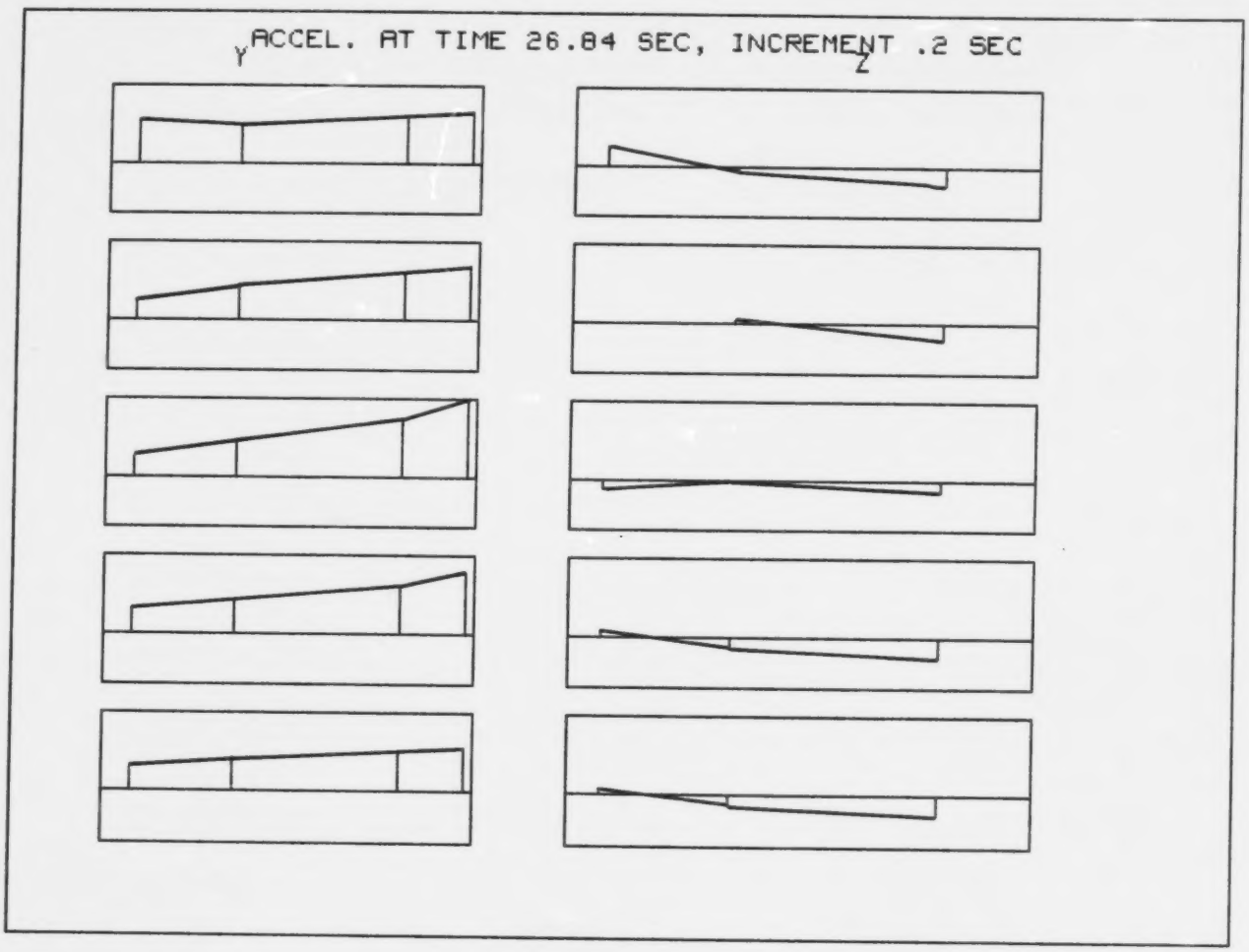
STATION POSITIONS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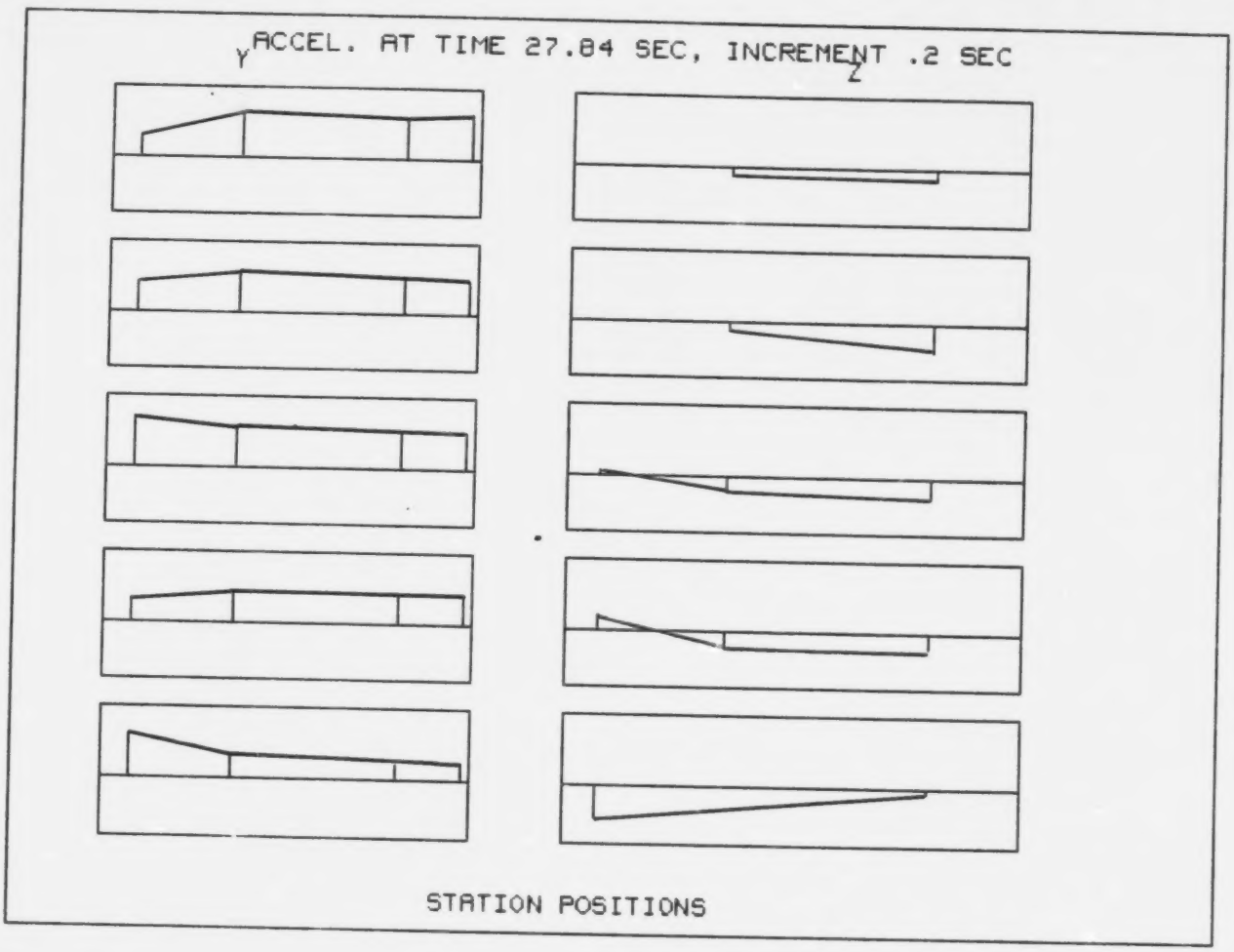
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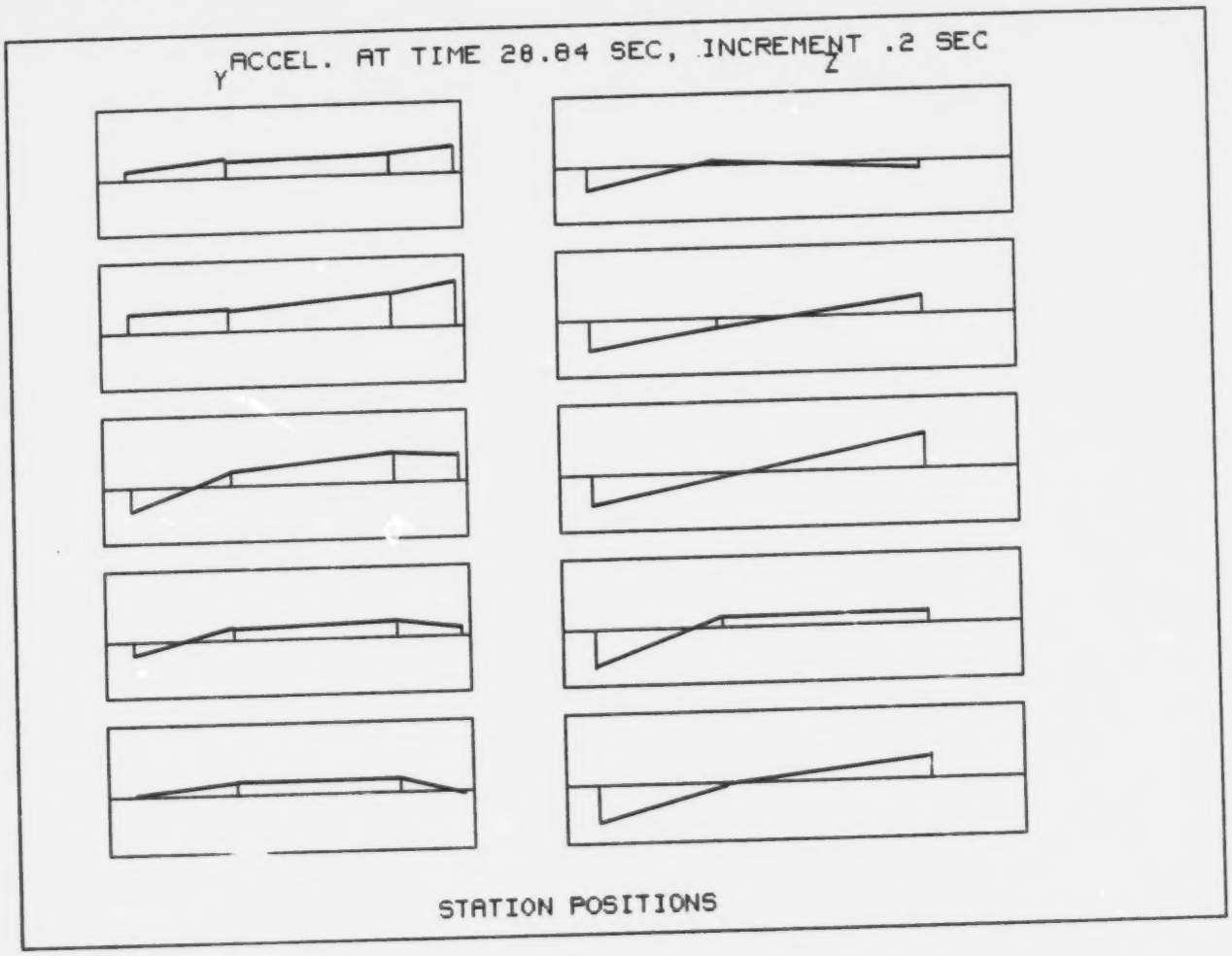
STATION POSITIONS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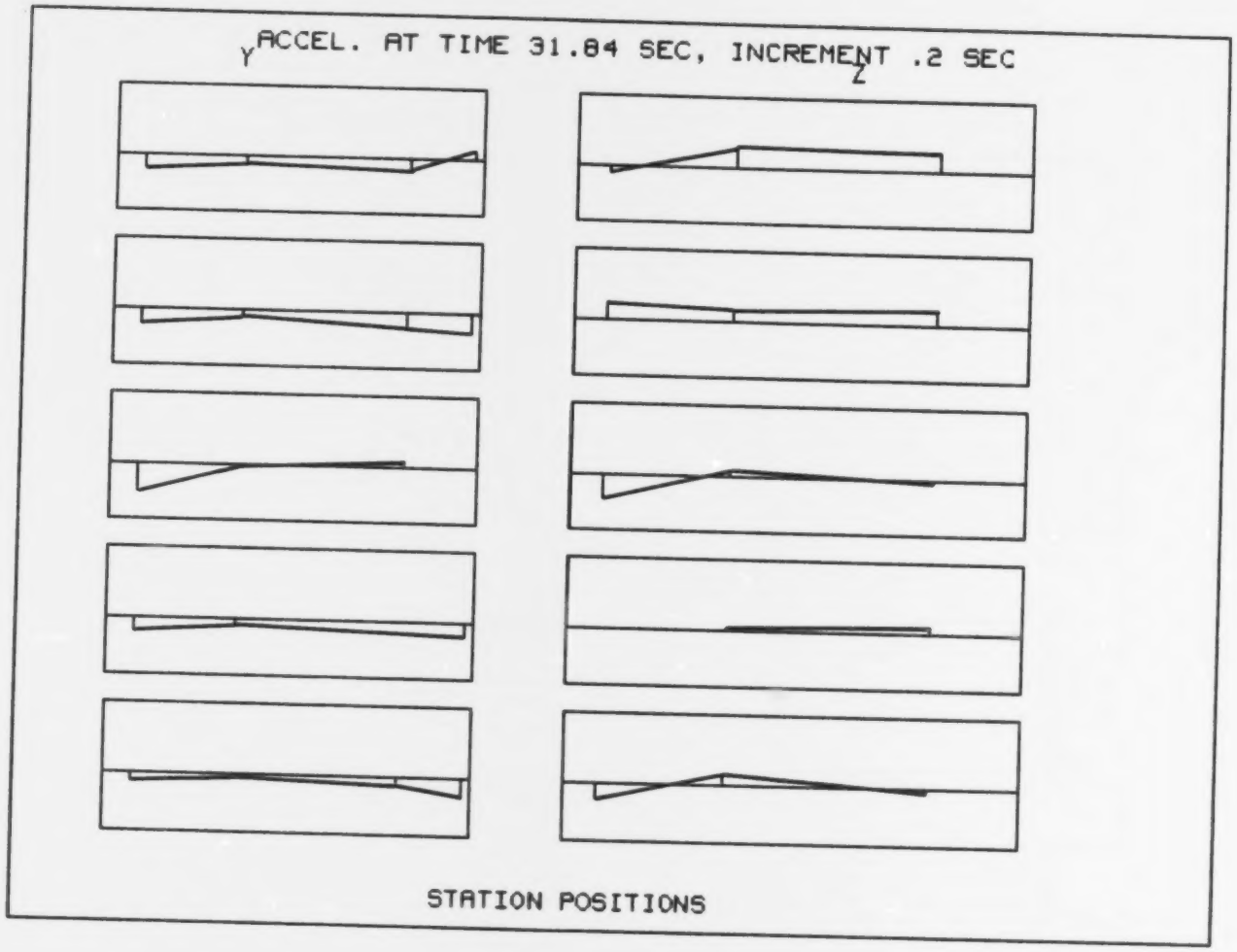
STATION POSITIONS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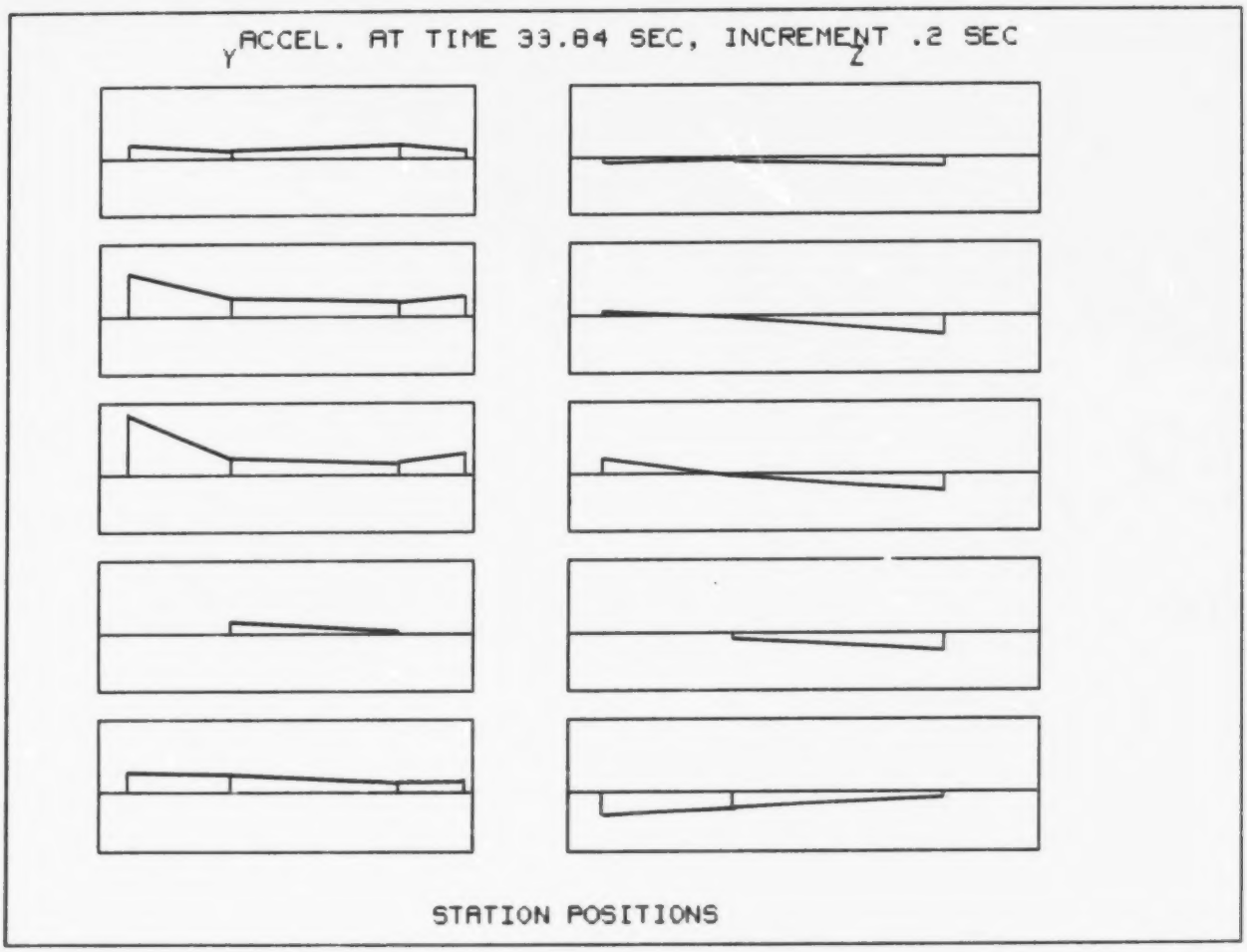
STATION POSITIONS


Y ACCEL. AT TIME 33.84 SEC, INCREMENT .2 SEC Z
STATION POSITIONS

USCGC POLAR SEA '81 TRIAL

RAMMING LEVEL ICE (02:09:06:09)

HEAD-ON, 5.33 Knots, 4 FT MAX. THICK ICE

ARCTEC CANADA
PLT464 - GRAPHICS

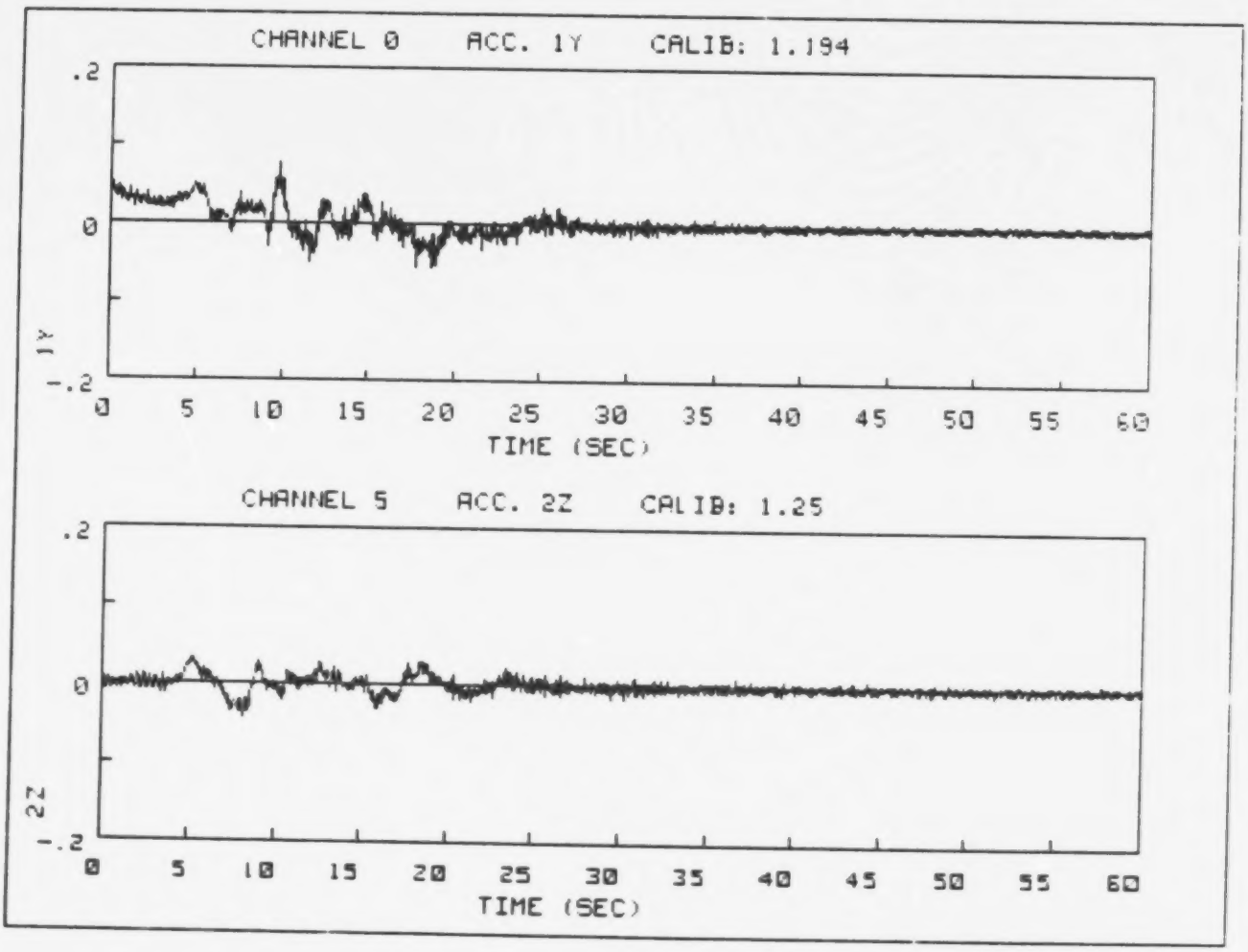
USCGC POLAR SEA -F.S. TEST RAMMING LEVEL ICE HEAD-ON

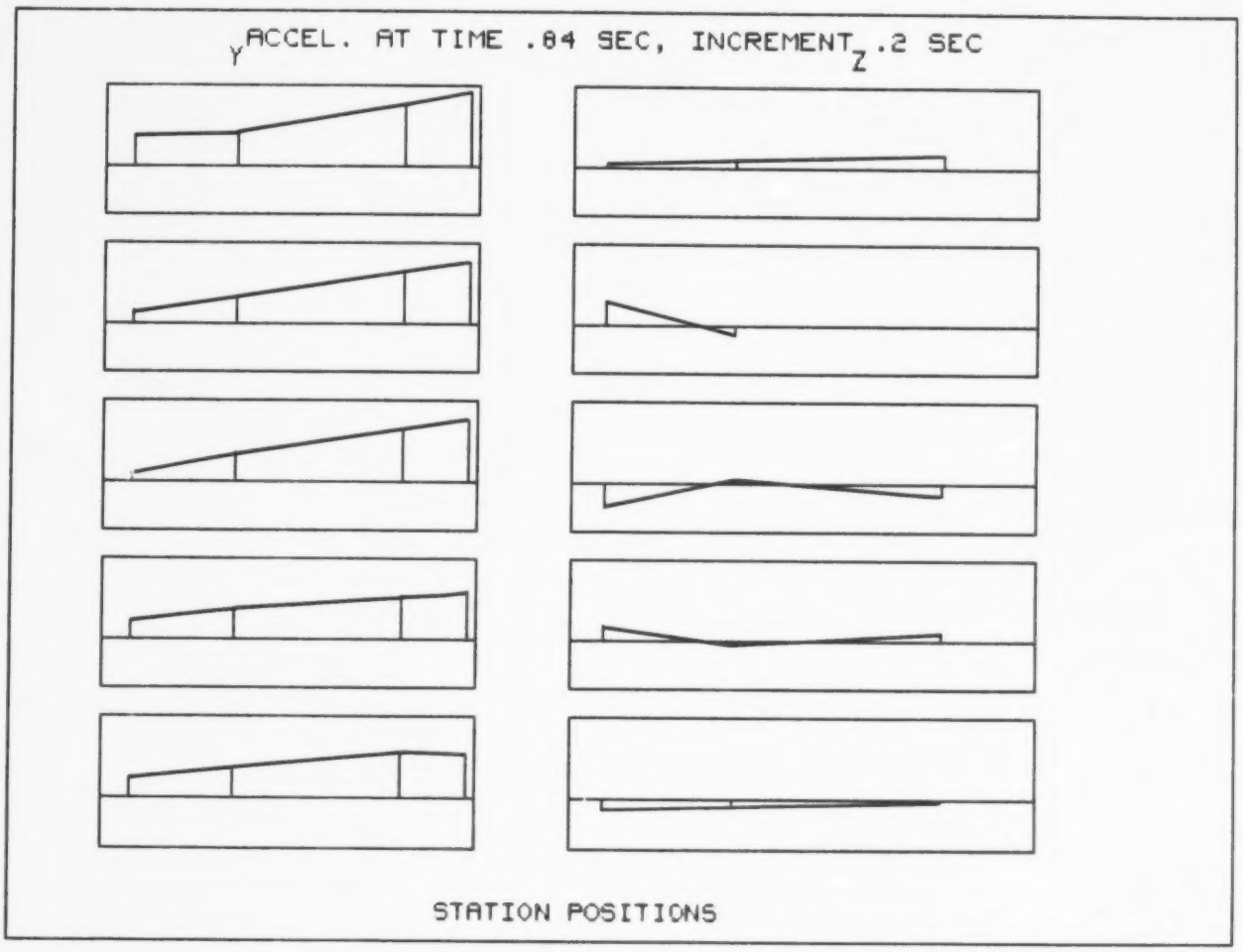
TEST CODE=F9-0 TEST DATE=FEB 9 1981 (06:09)

ICE TYPE=LEVEL ICE COVERAGE=100 % THICKNESS=4' max.

DIGITIZED DATE=09:04:12:39:10

PLOT STEP SIZE= 1

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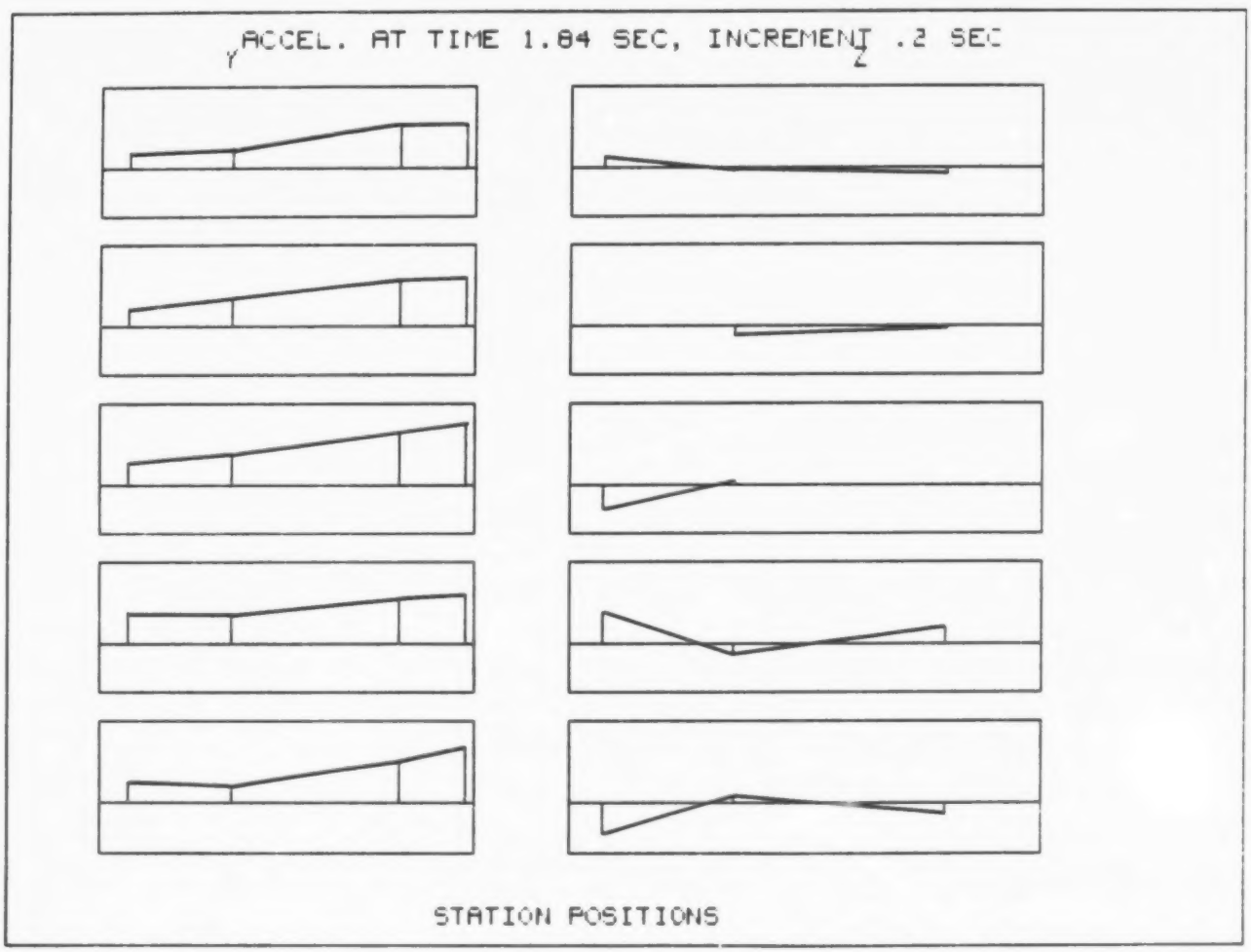
STATION POSITIONS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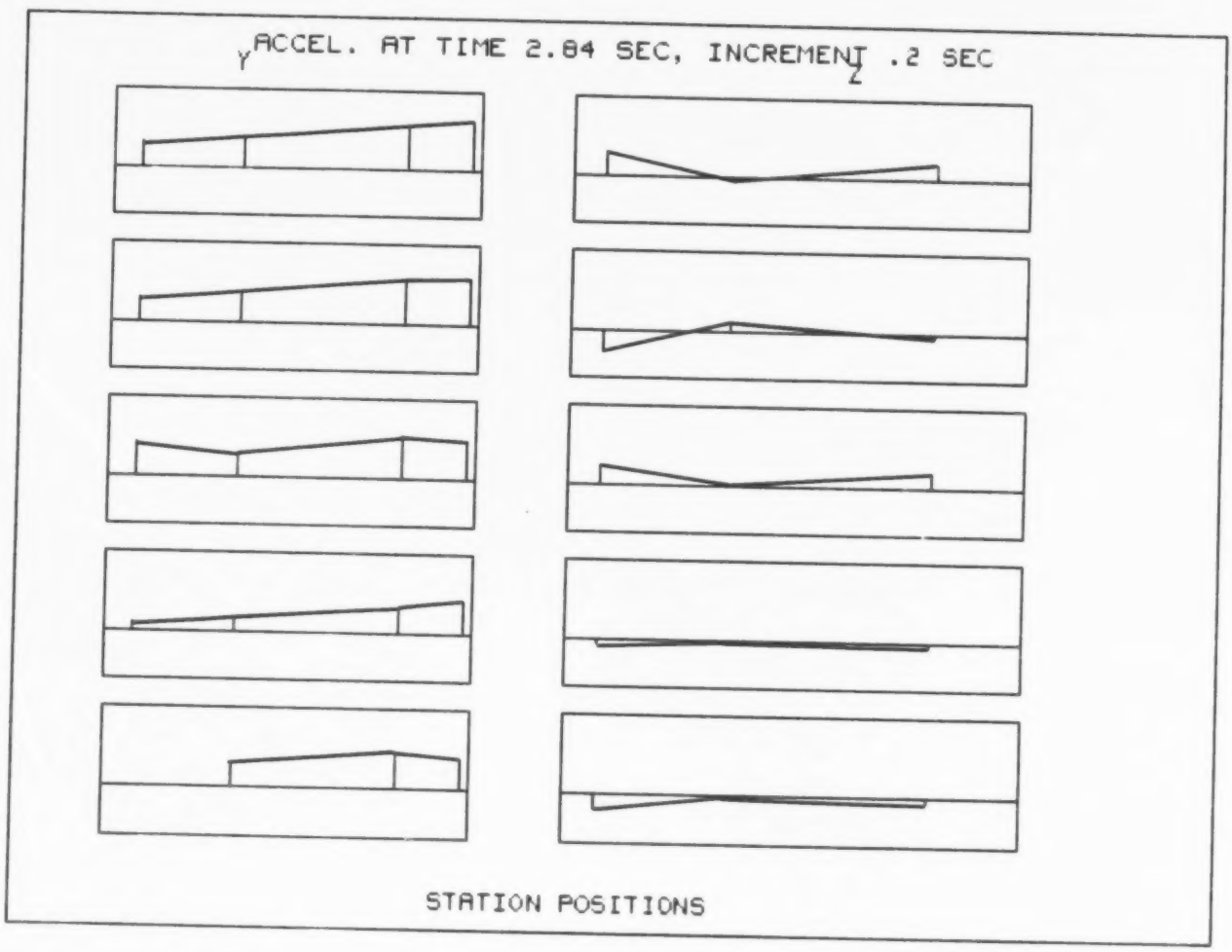
STATION POSITIONS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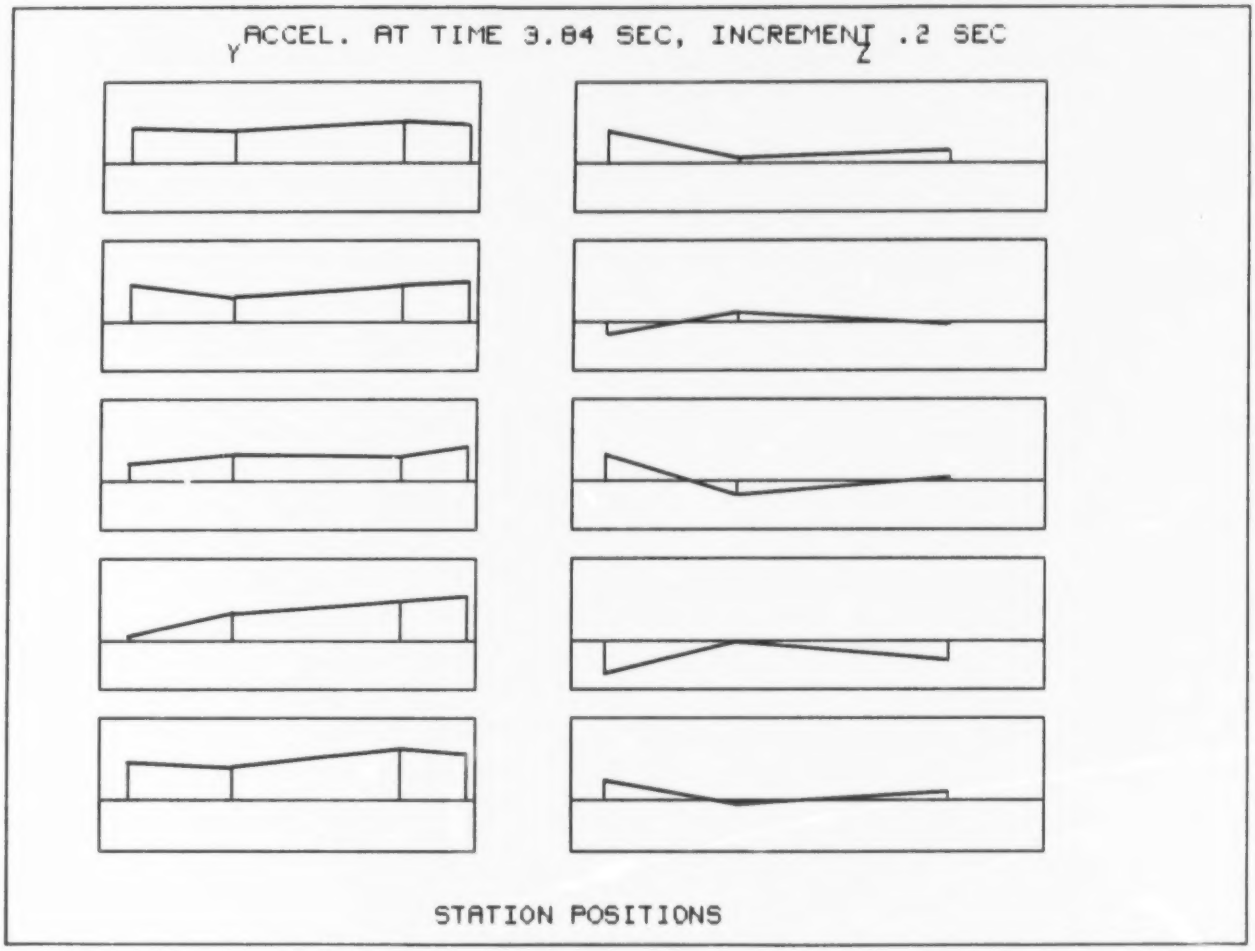
STATION POSITIONS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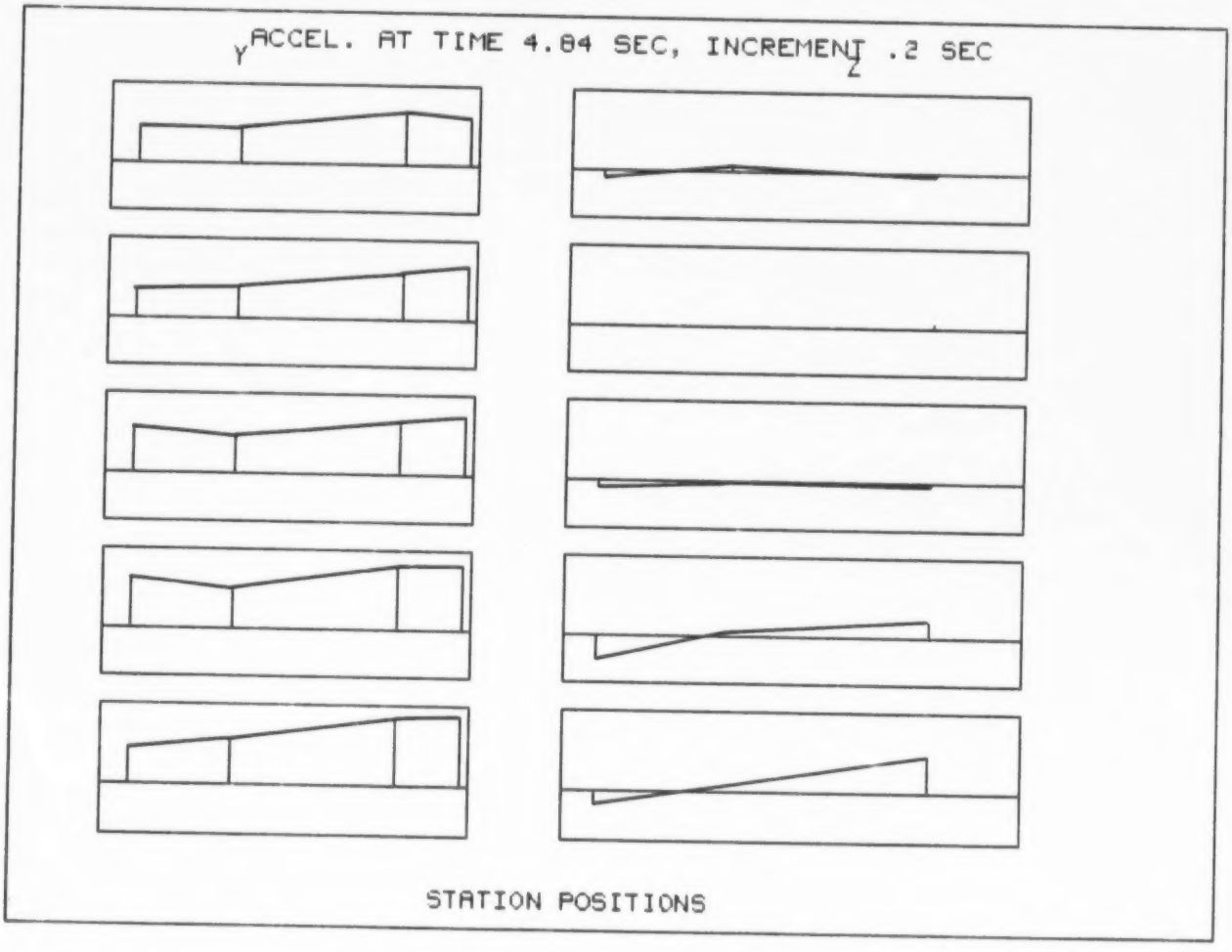
STATION POSITIONS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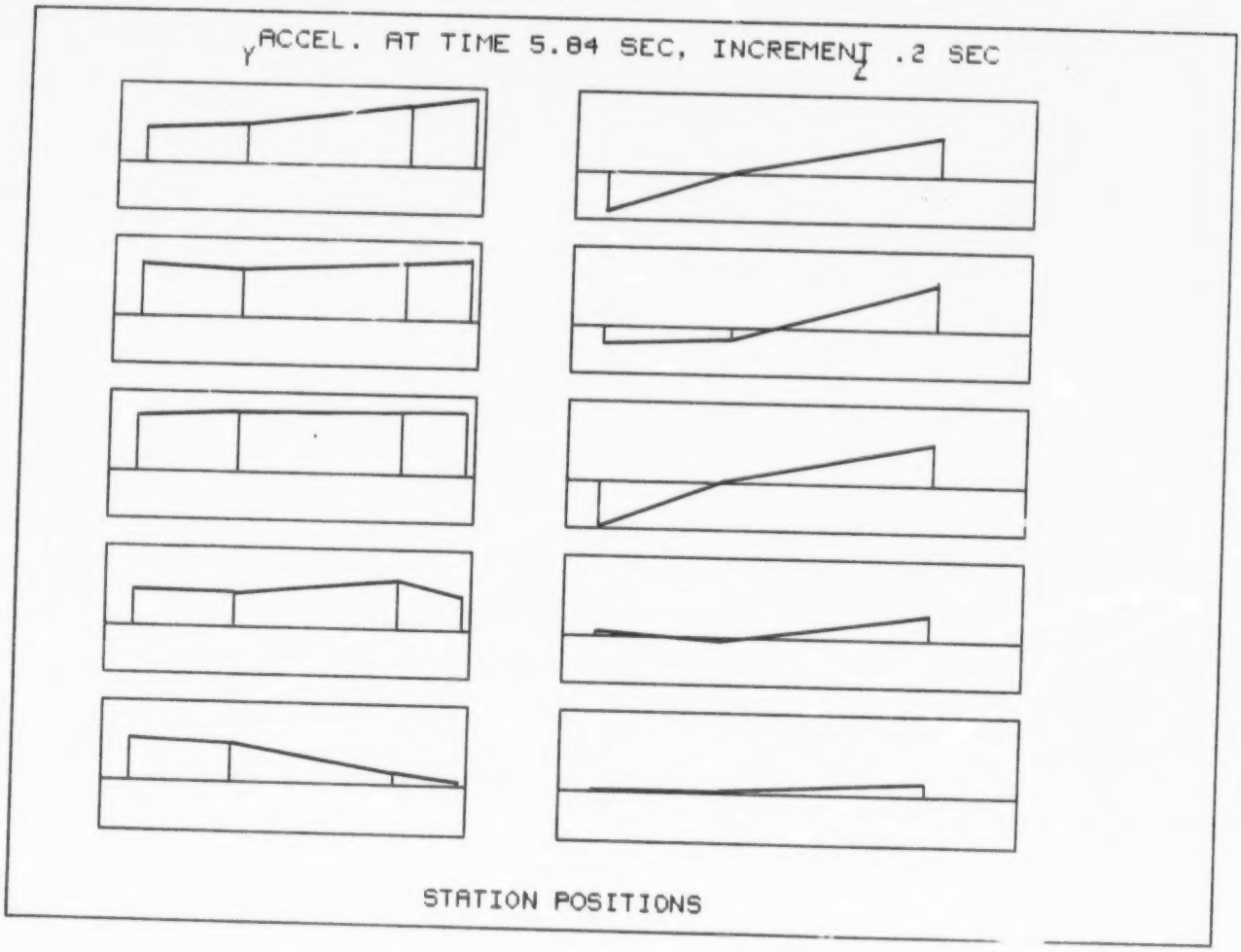
STATION POSITIONS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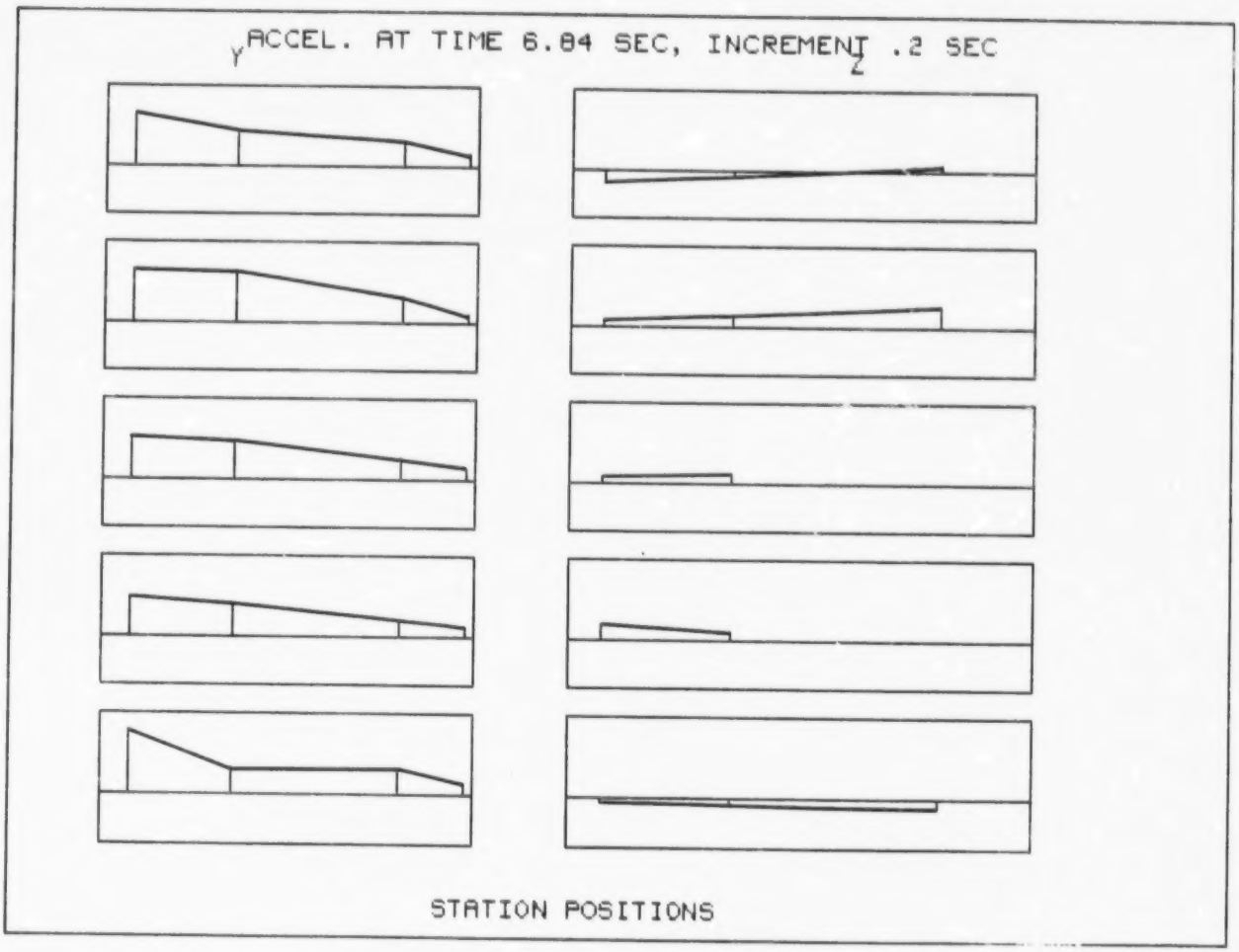
STATION POSITIONS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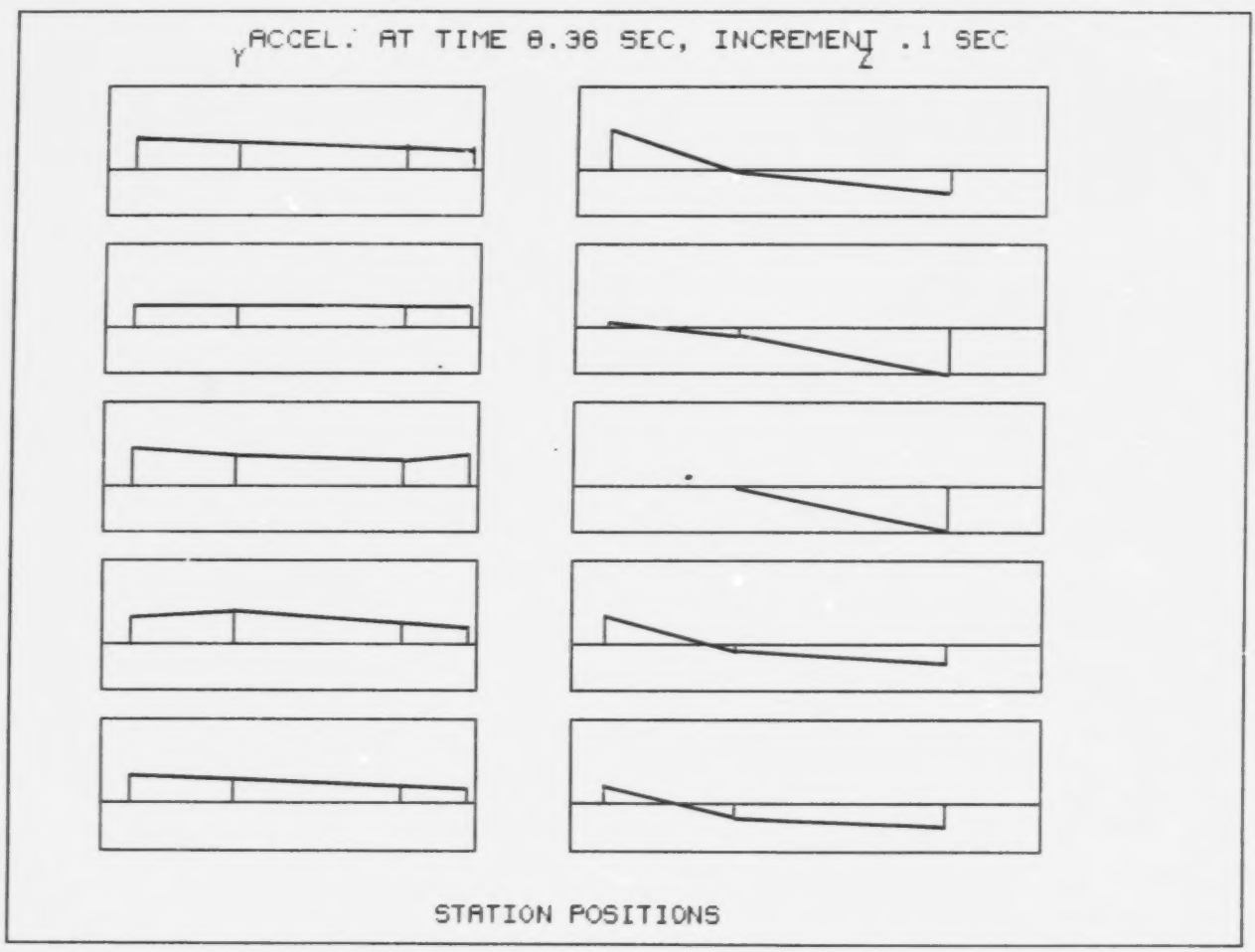
STATION POSITIONS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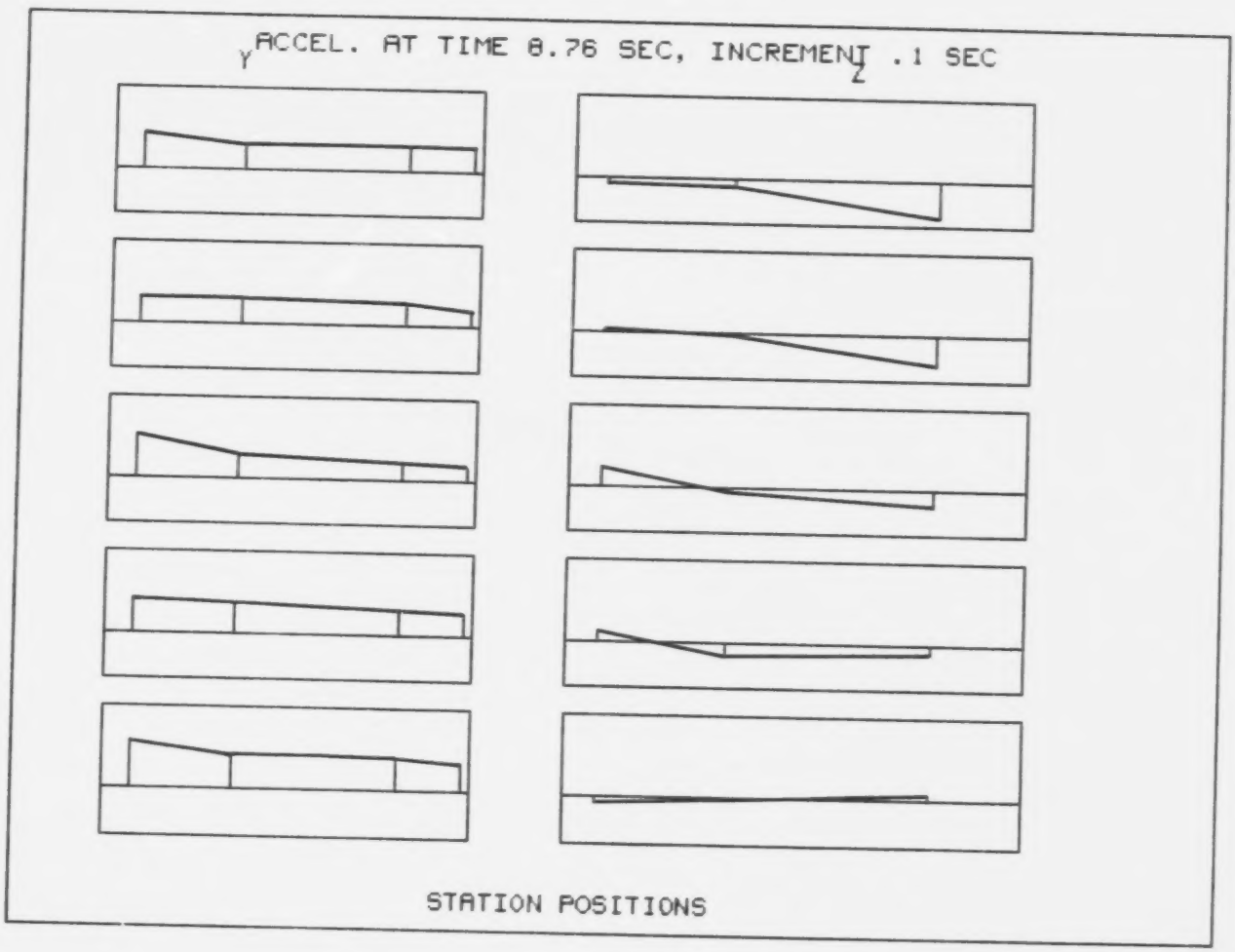
STATION POSITIONS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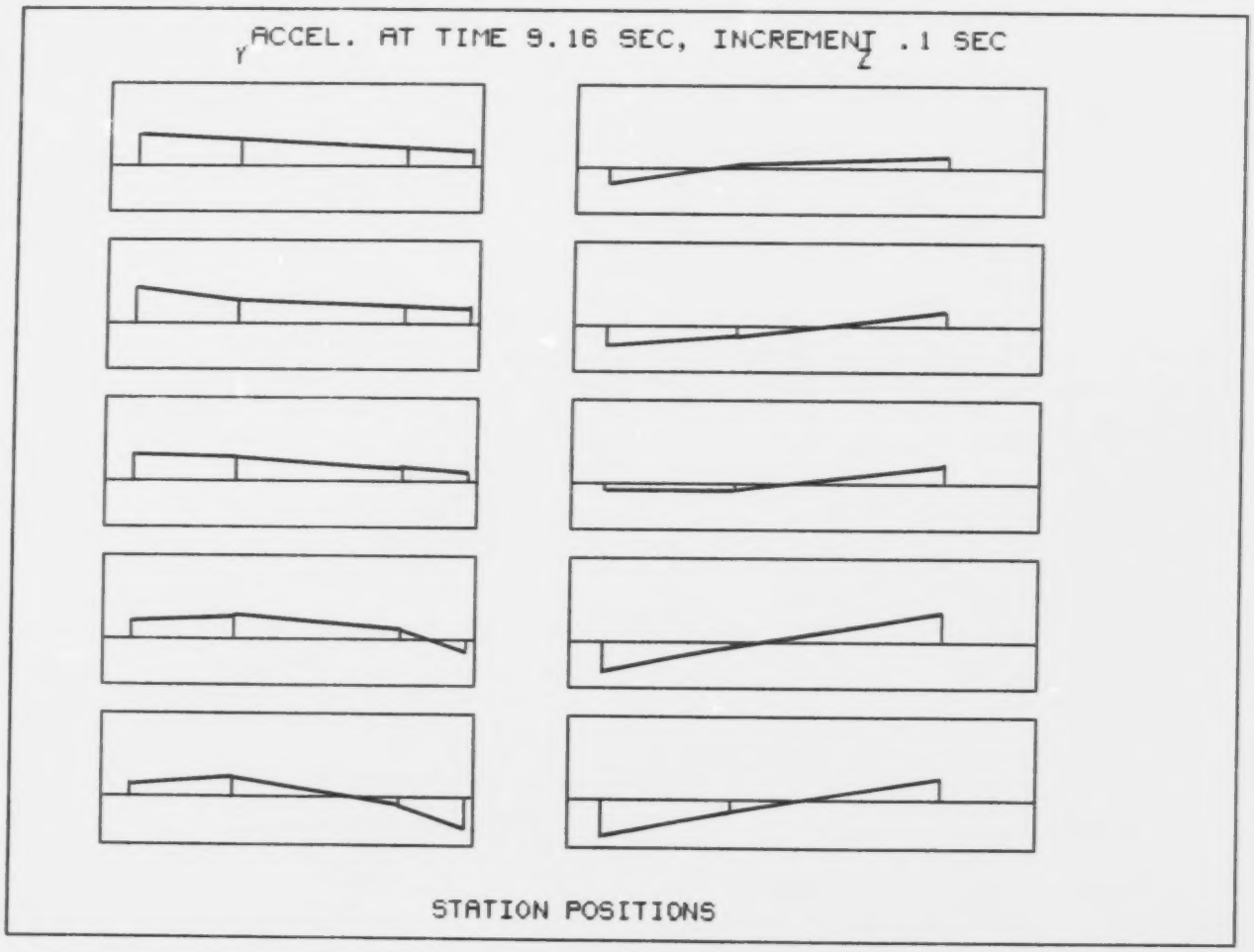
STATION POSITIONS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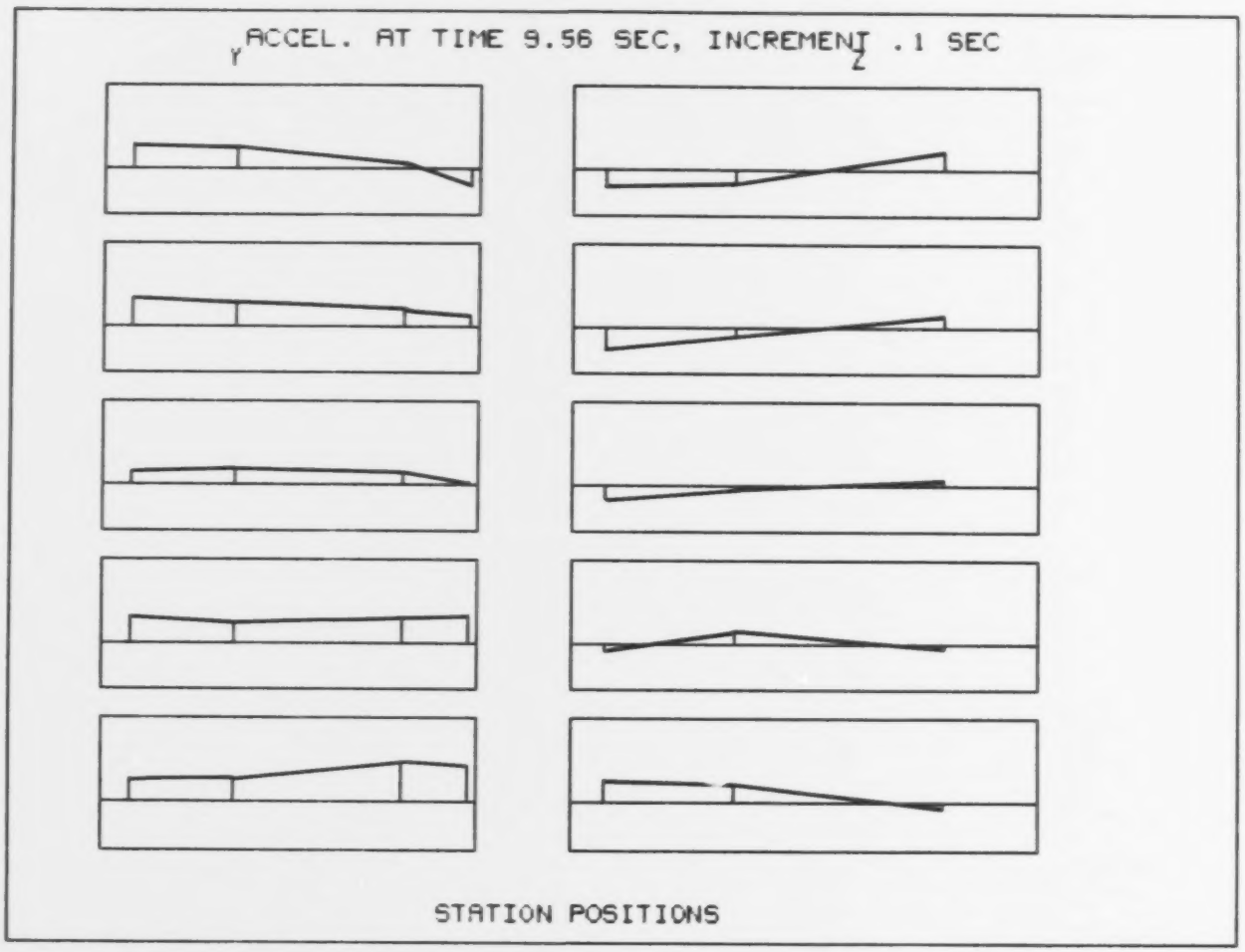
Z
STATION POSITIONS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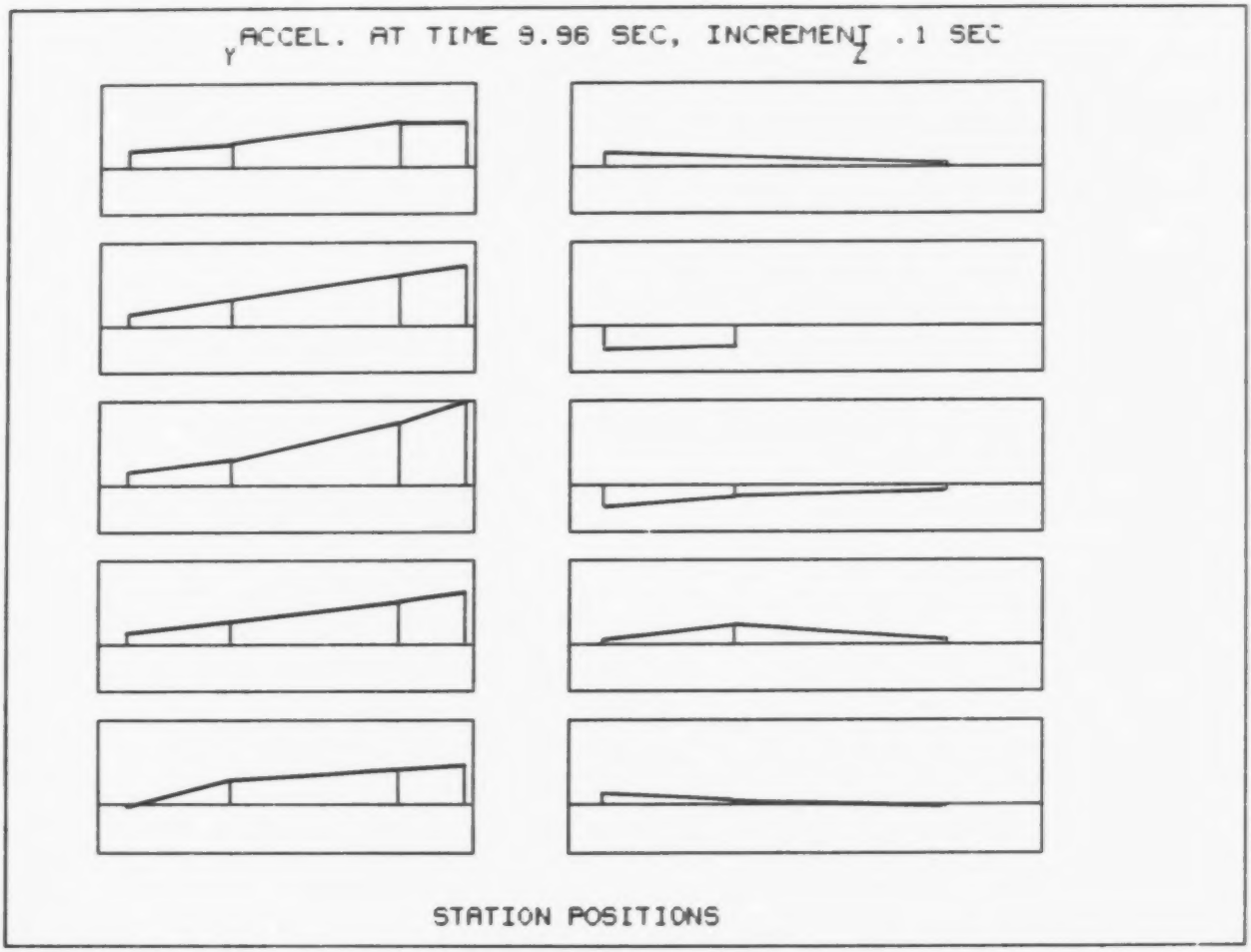
STATION POSITIONS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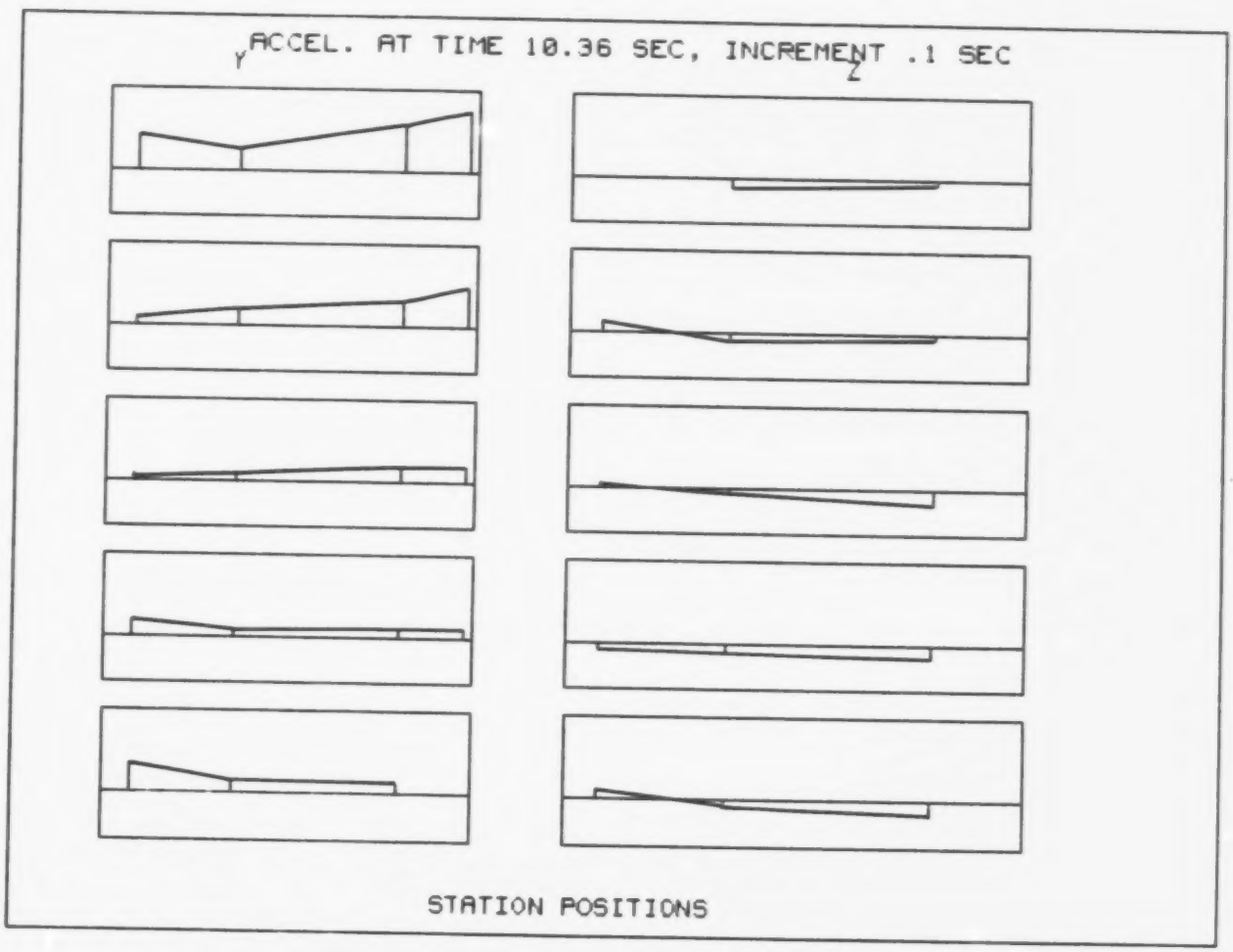
STATION POSITIONS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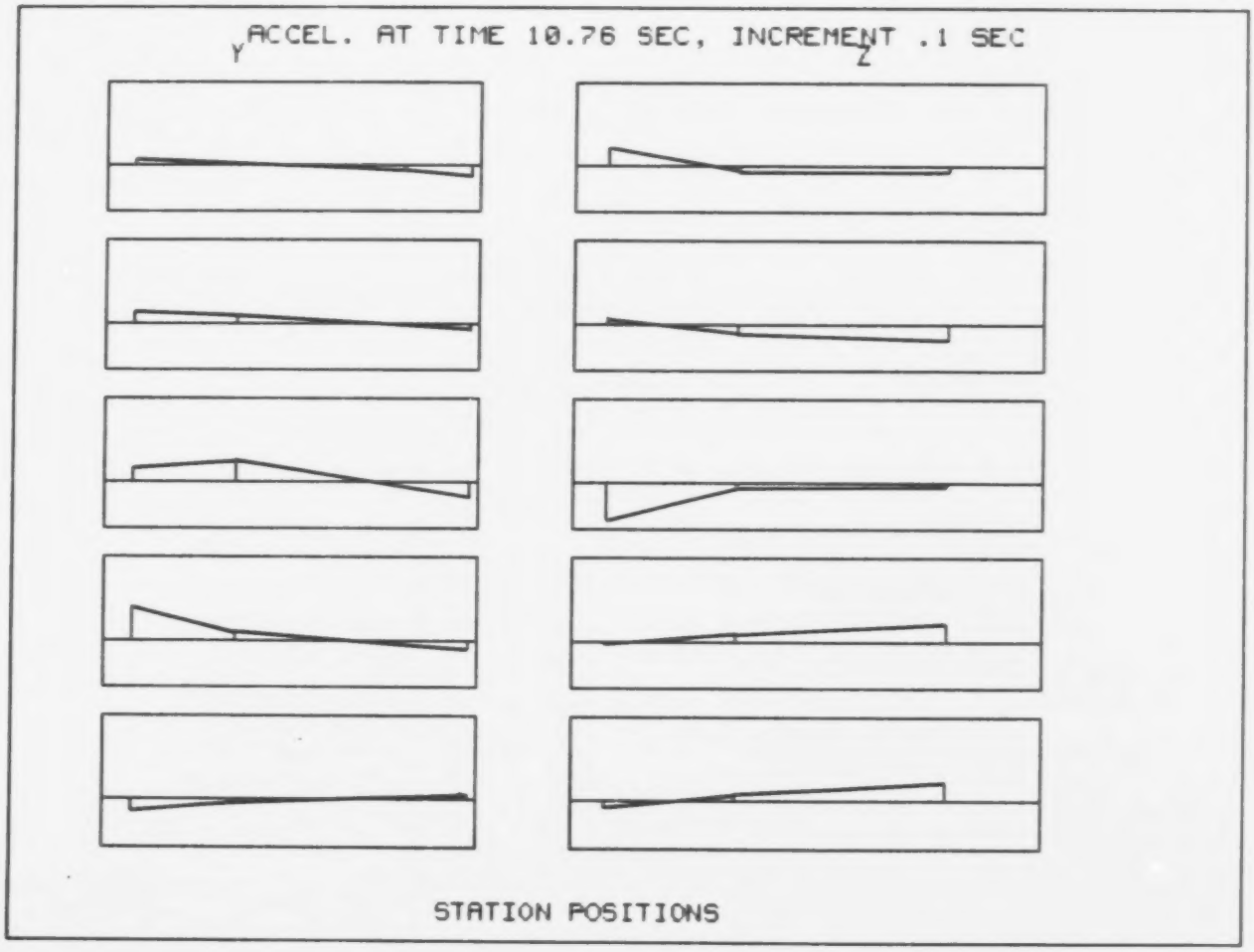
STATION POSITIONS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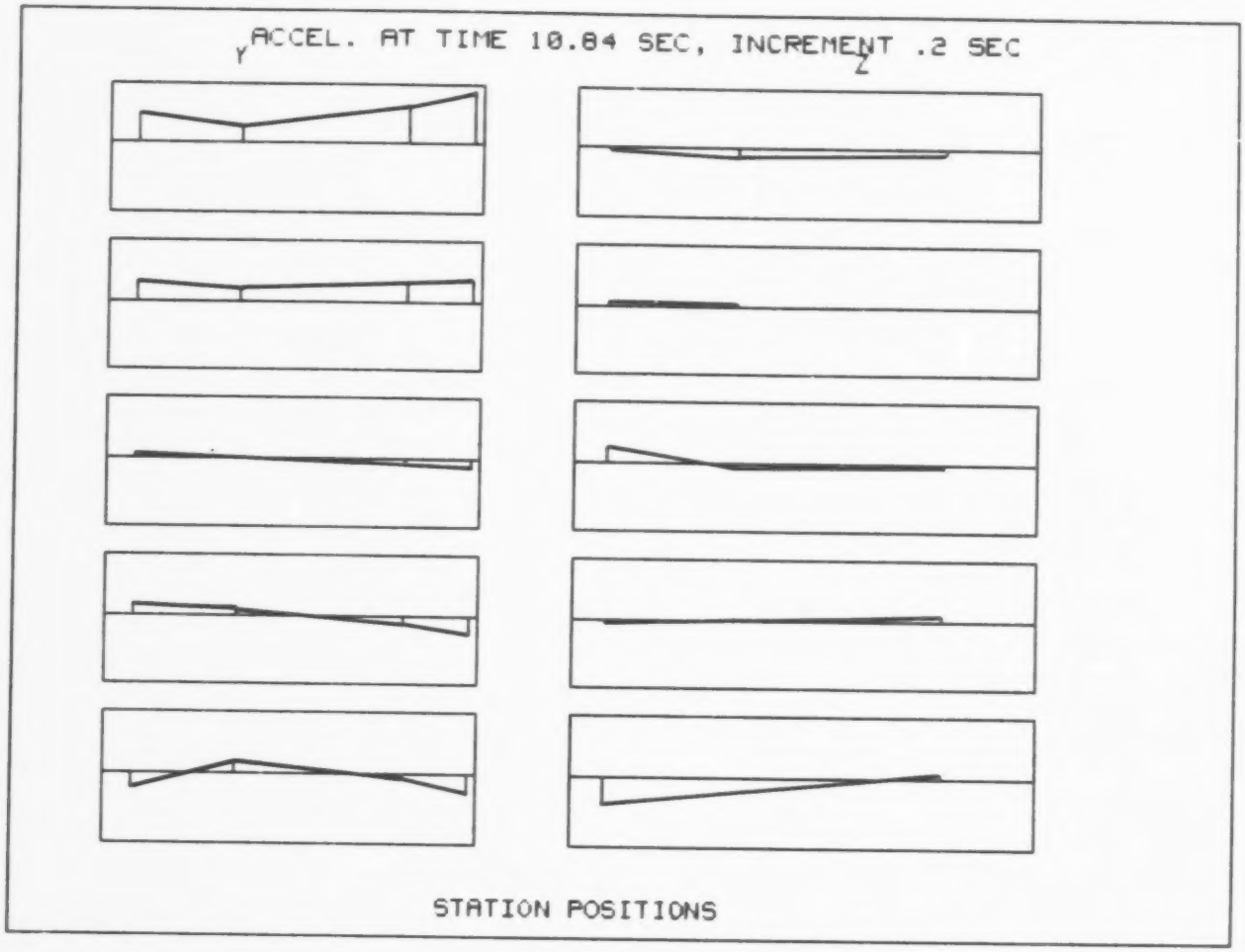
STATION POSITIONS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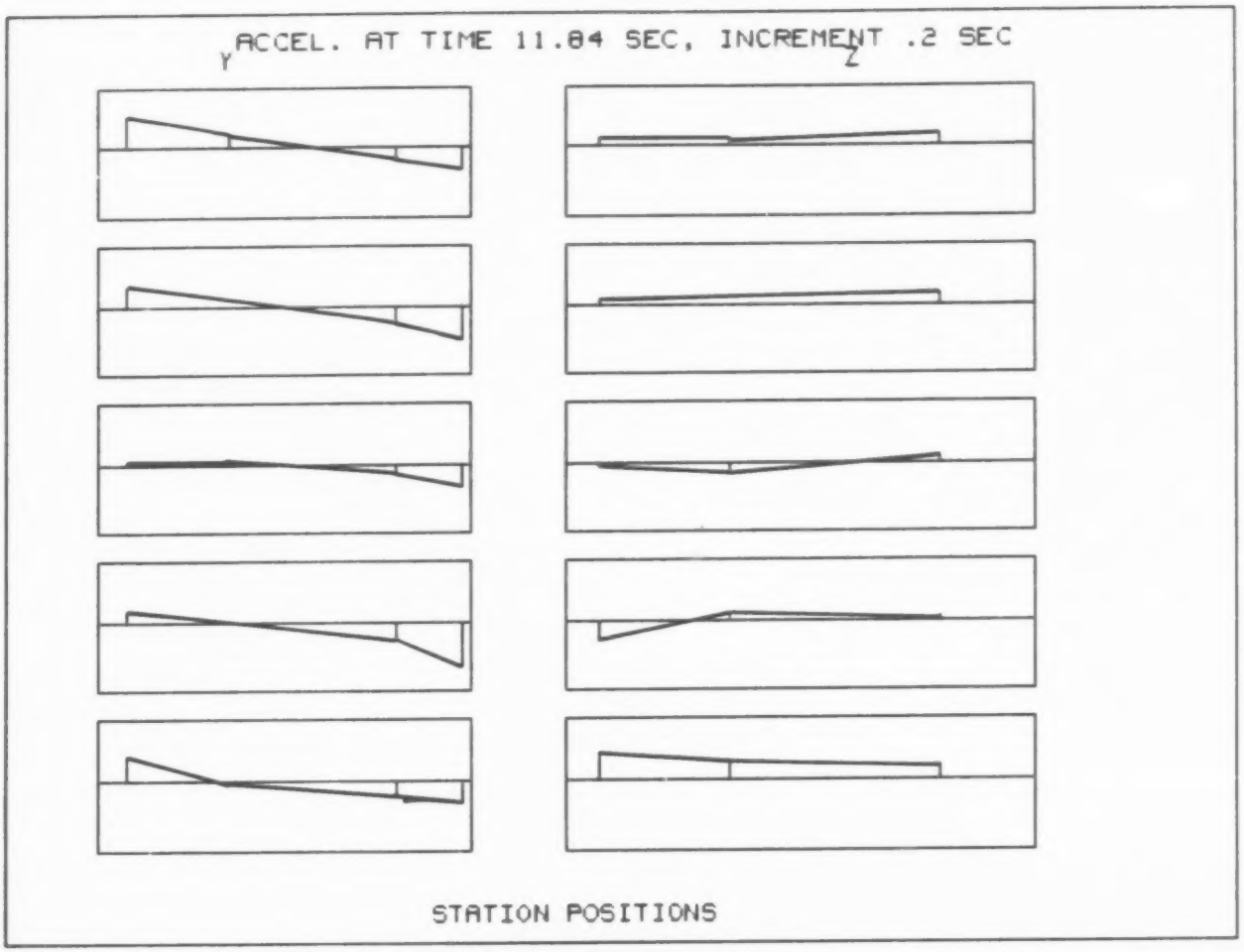
STATION POSITIONS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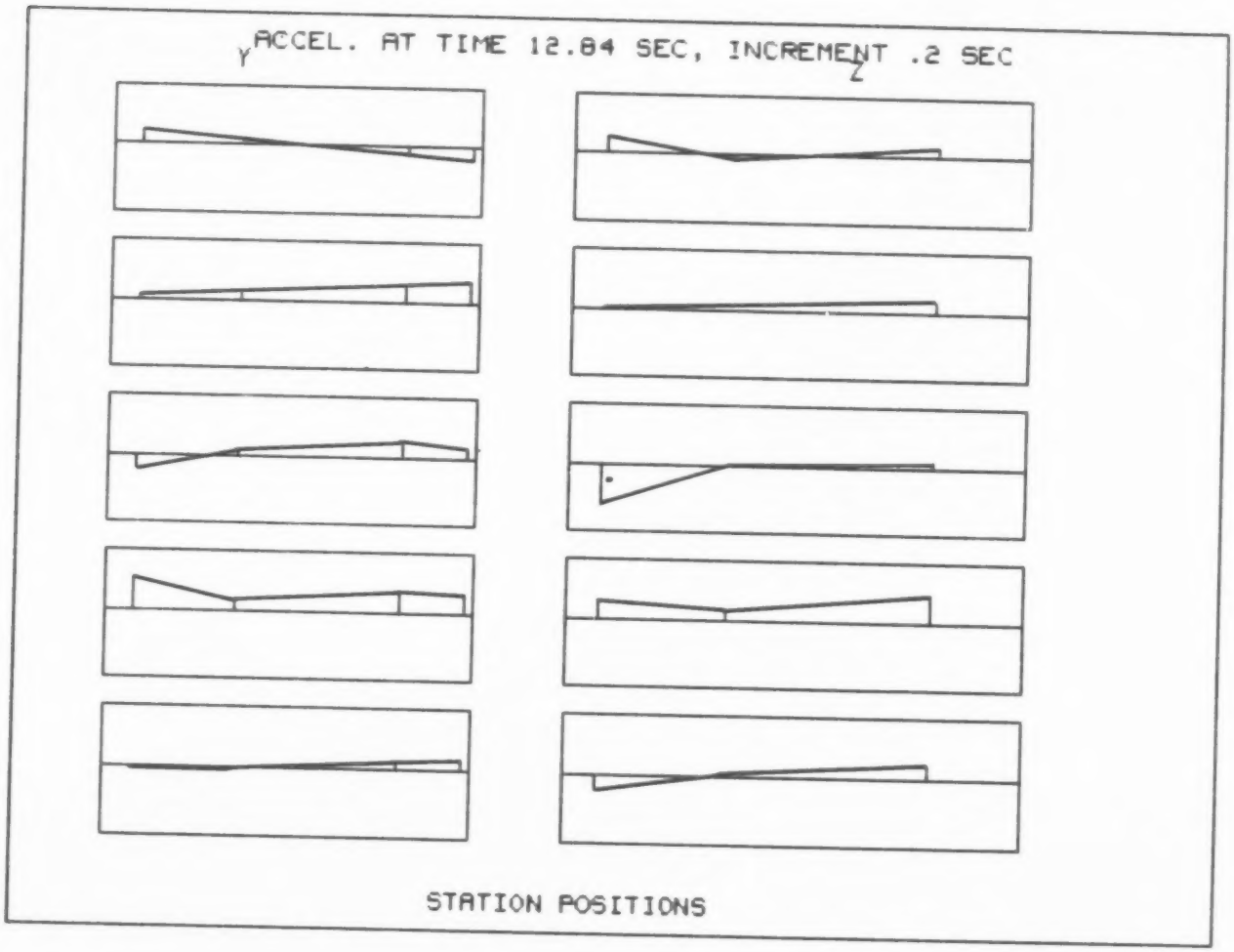
STATION POSITIONS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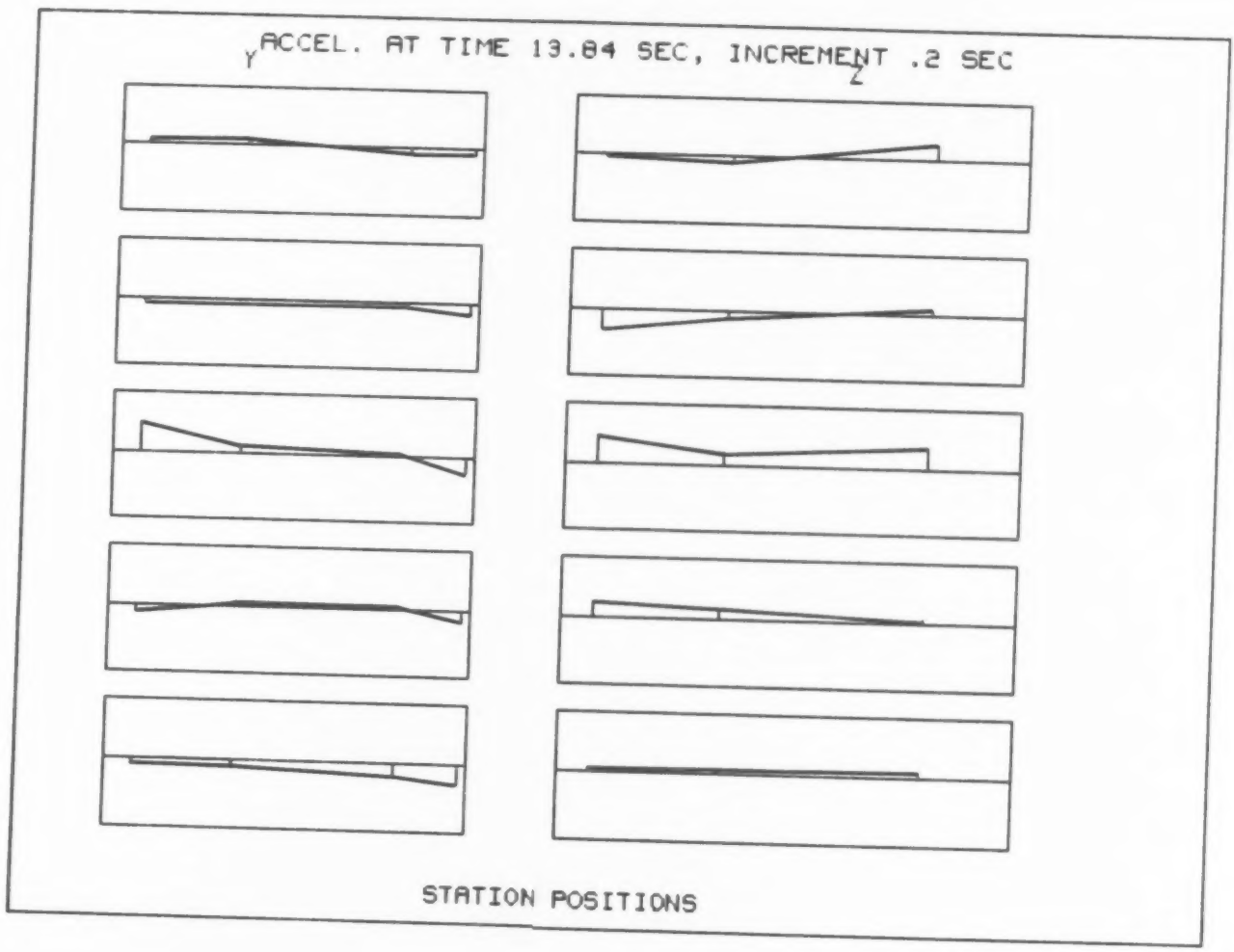
STATION POSITIONS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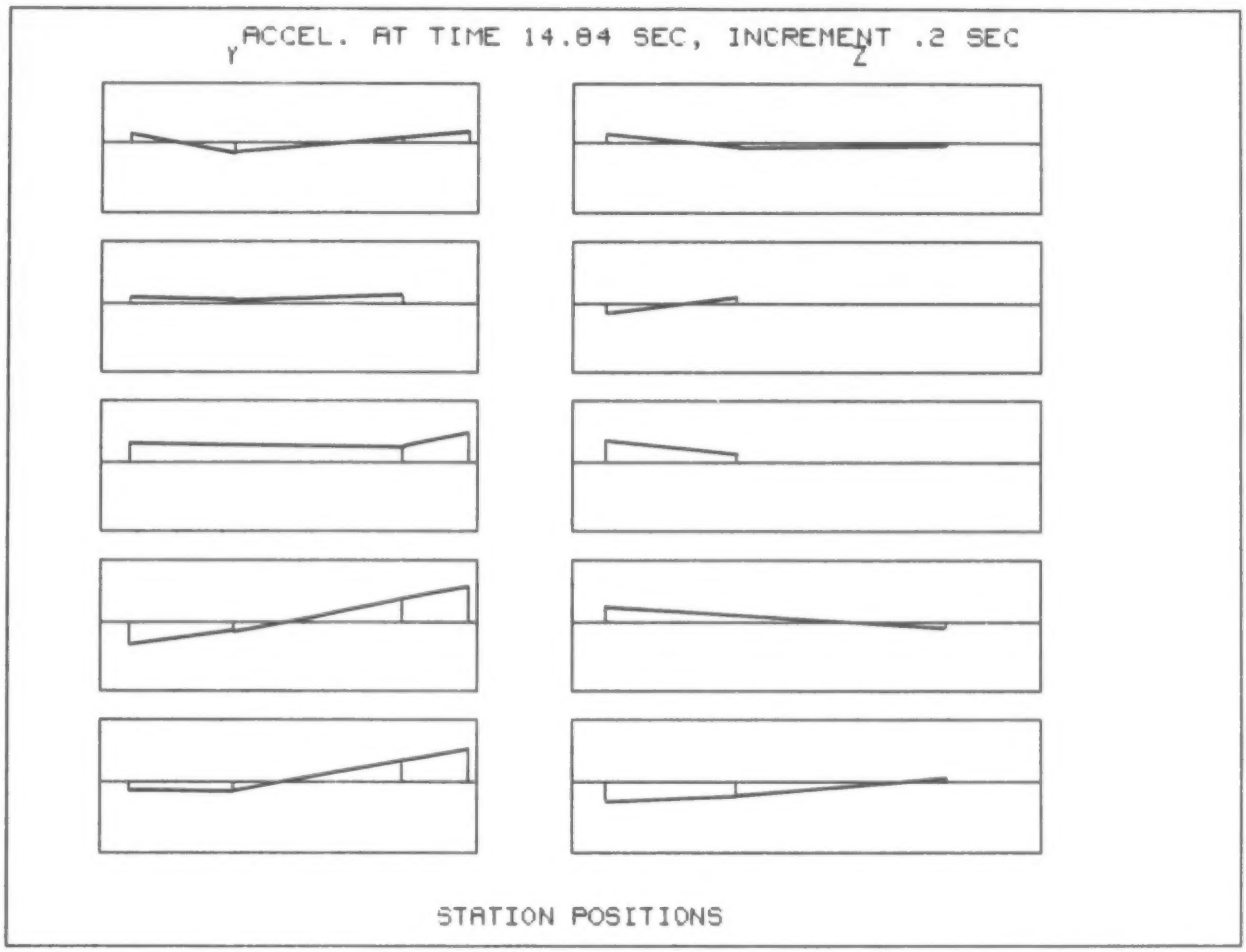
STATION POSITIONS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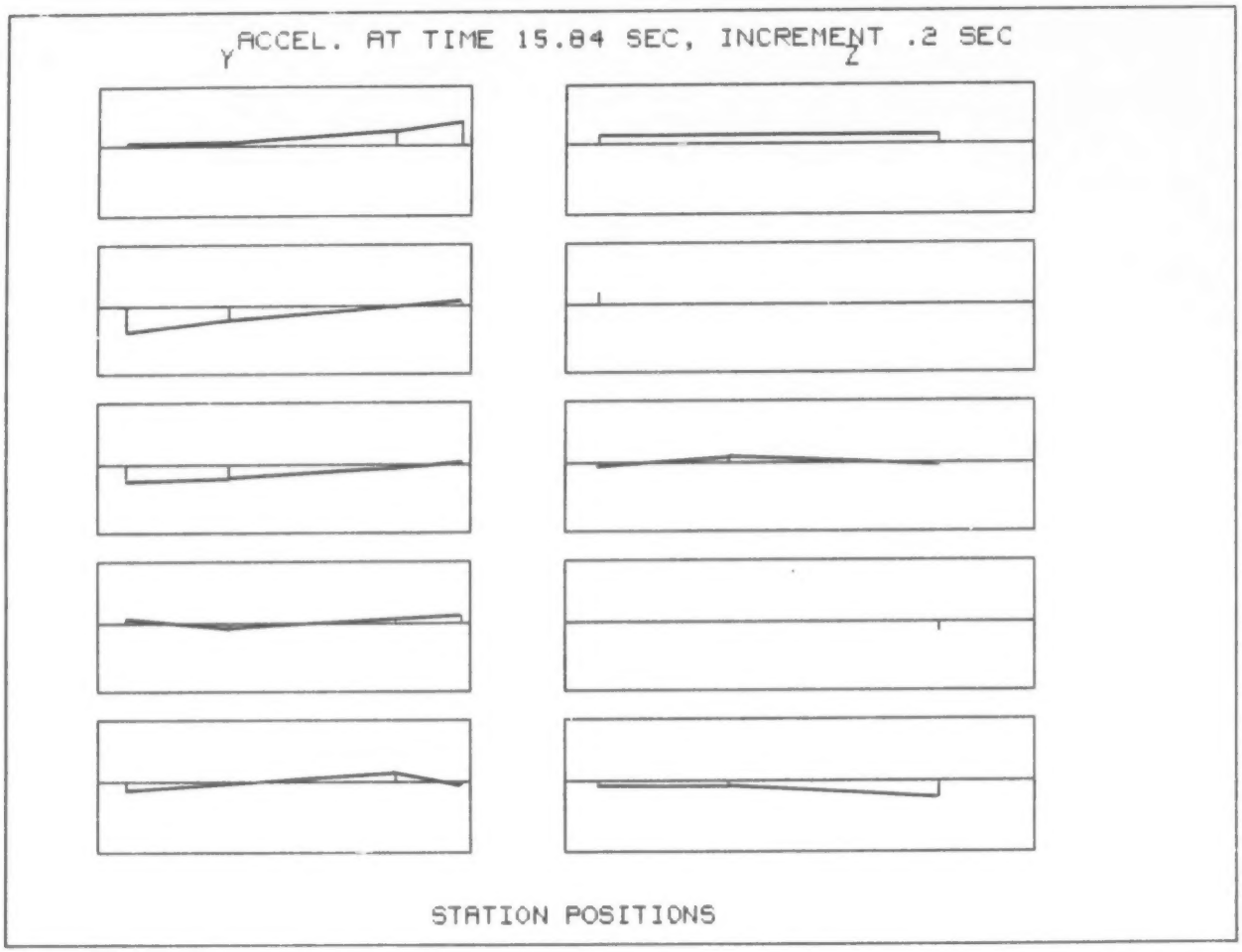
STATION POSITIONS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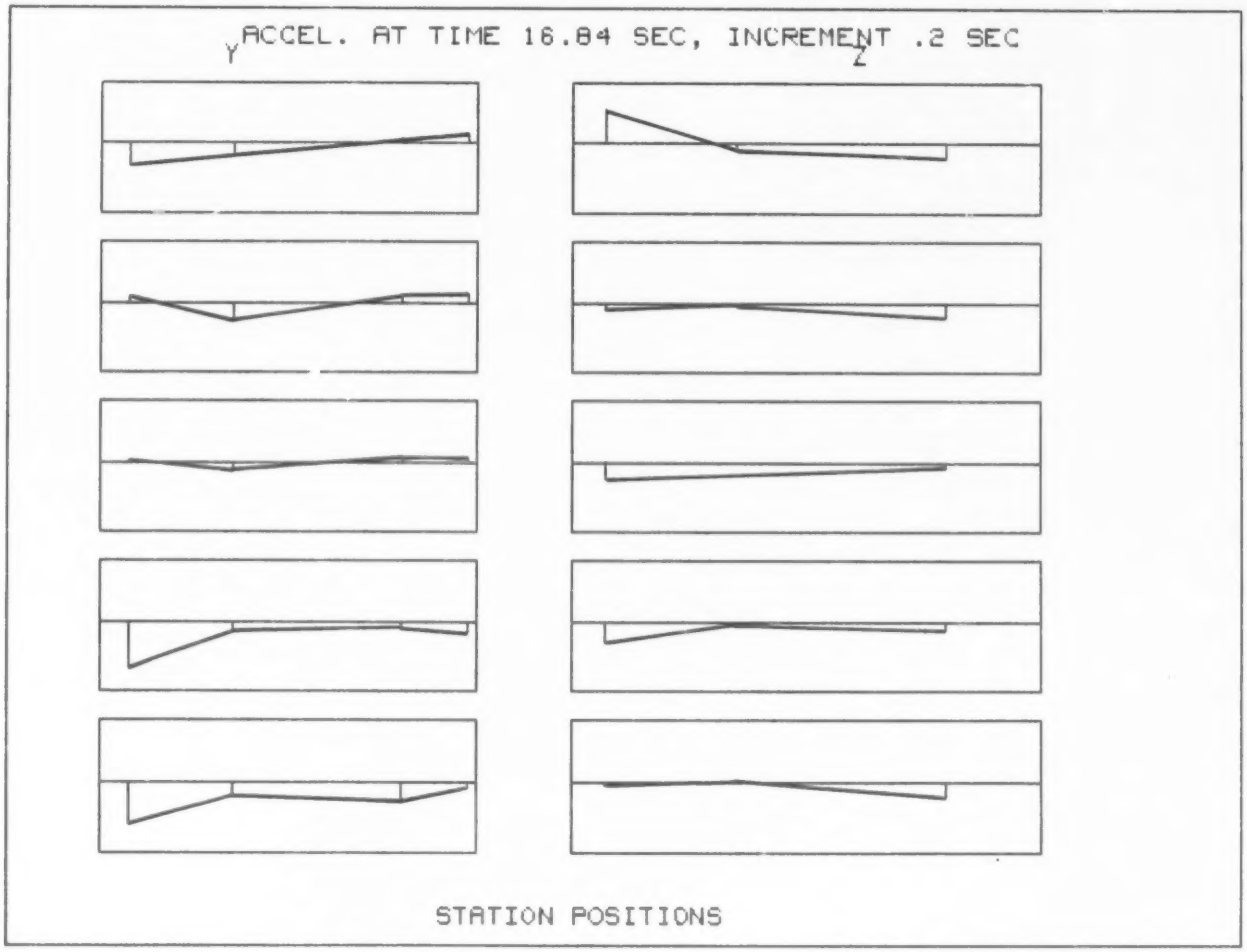
STATION POSITIONS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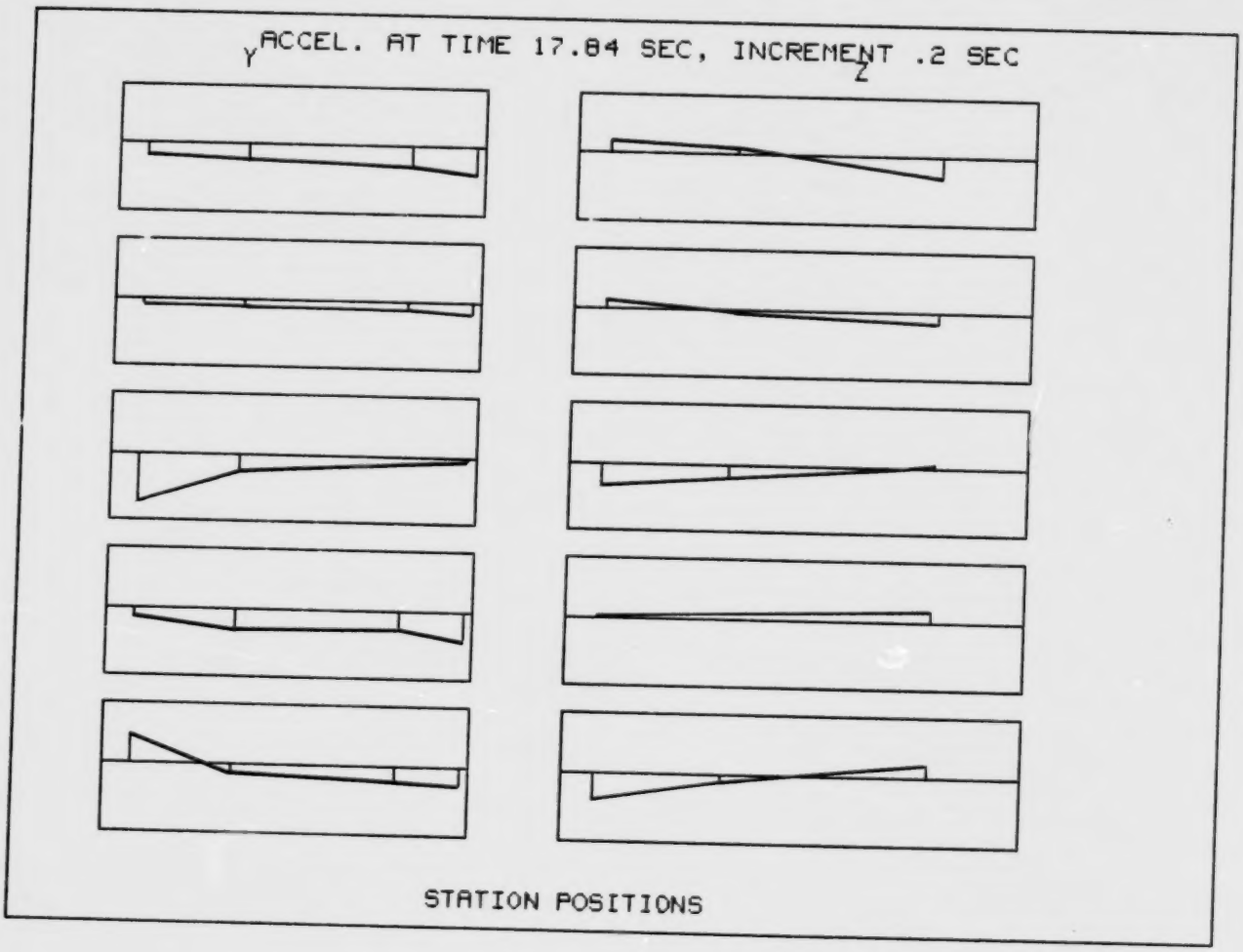
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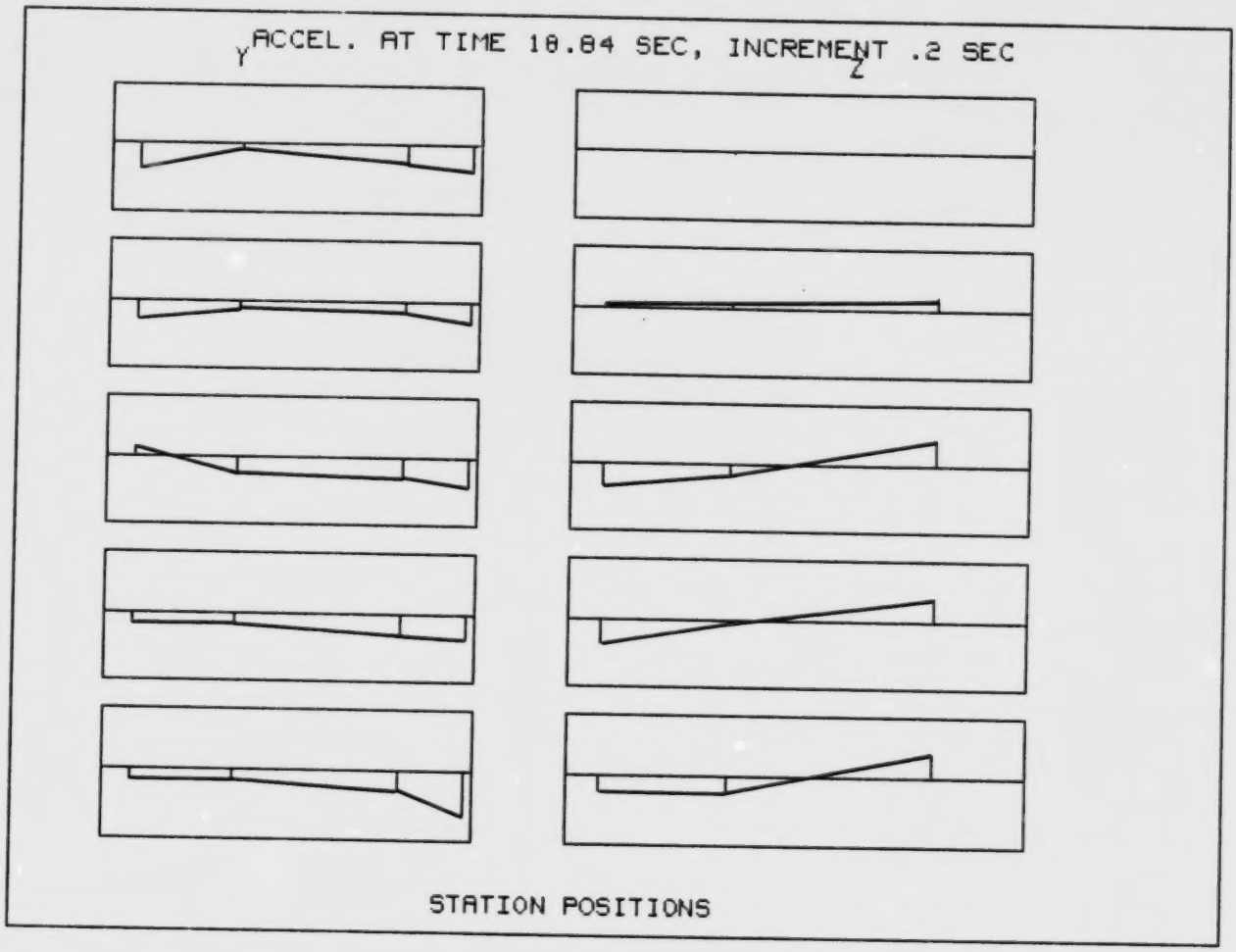
STATION POSITIONS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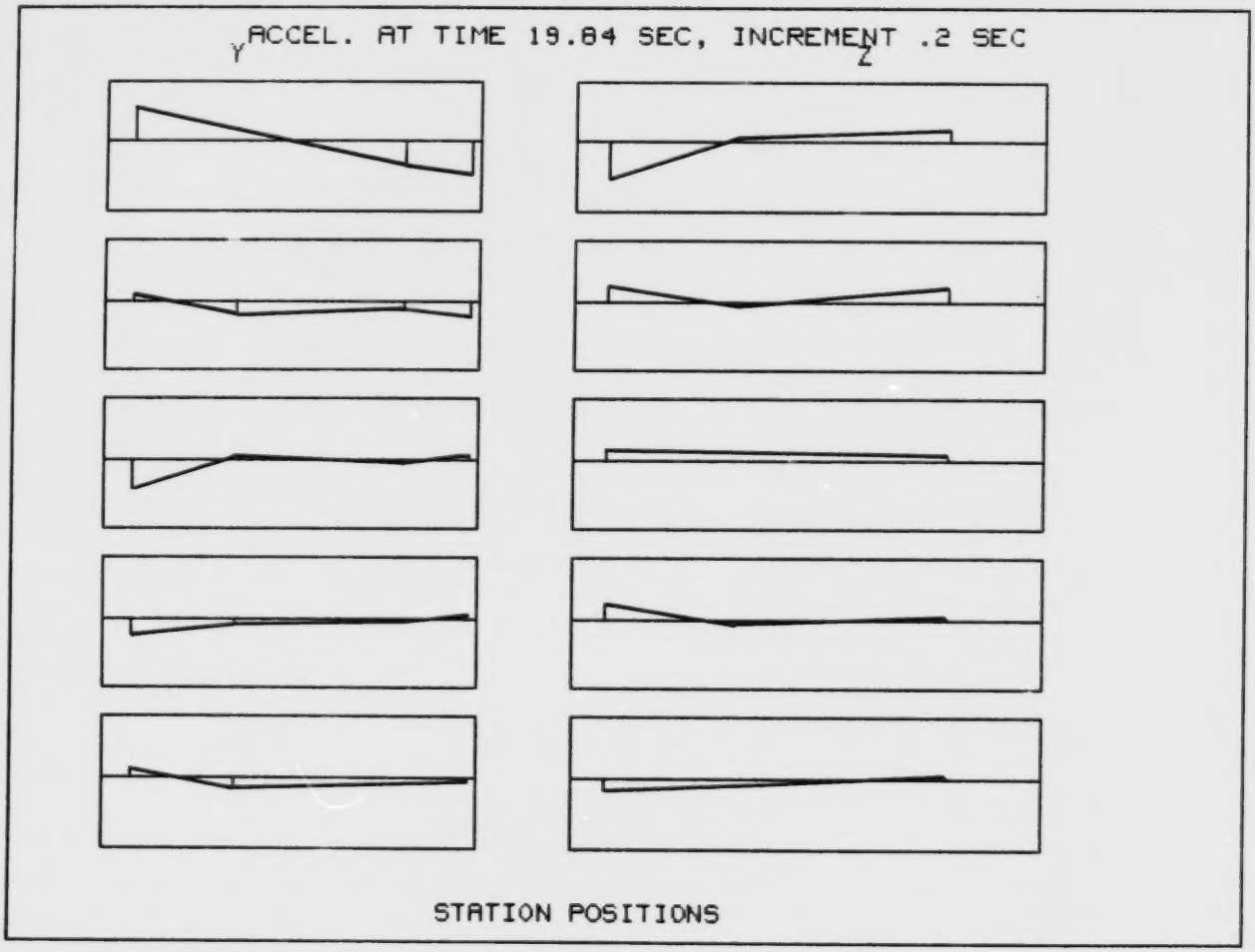
STATION POSITIONS


Y
ACCEL. AT TIME 19.84 SEC, INCREMENT .2 SEC
Z
STATION POSITIONS

USCGC POLAR SEA '81 TRIAL

RAMMING LEVEL ICE (02:09:13:50)

HEAD-ON, 12 Knots, MAX 3', AVG 3' ICE

ARCTEC CANADA
PLT464 - GRAPHICS

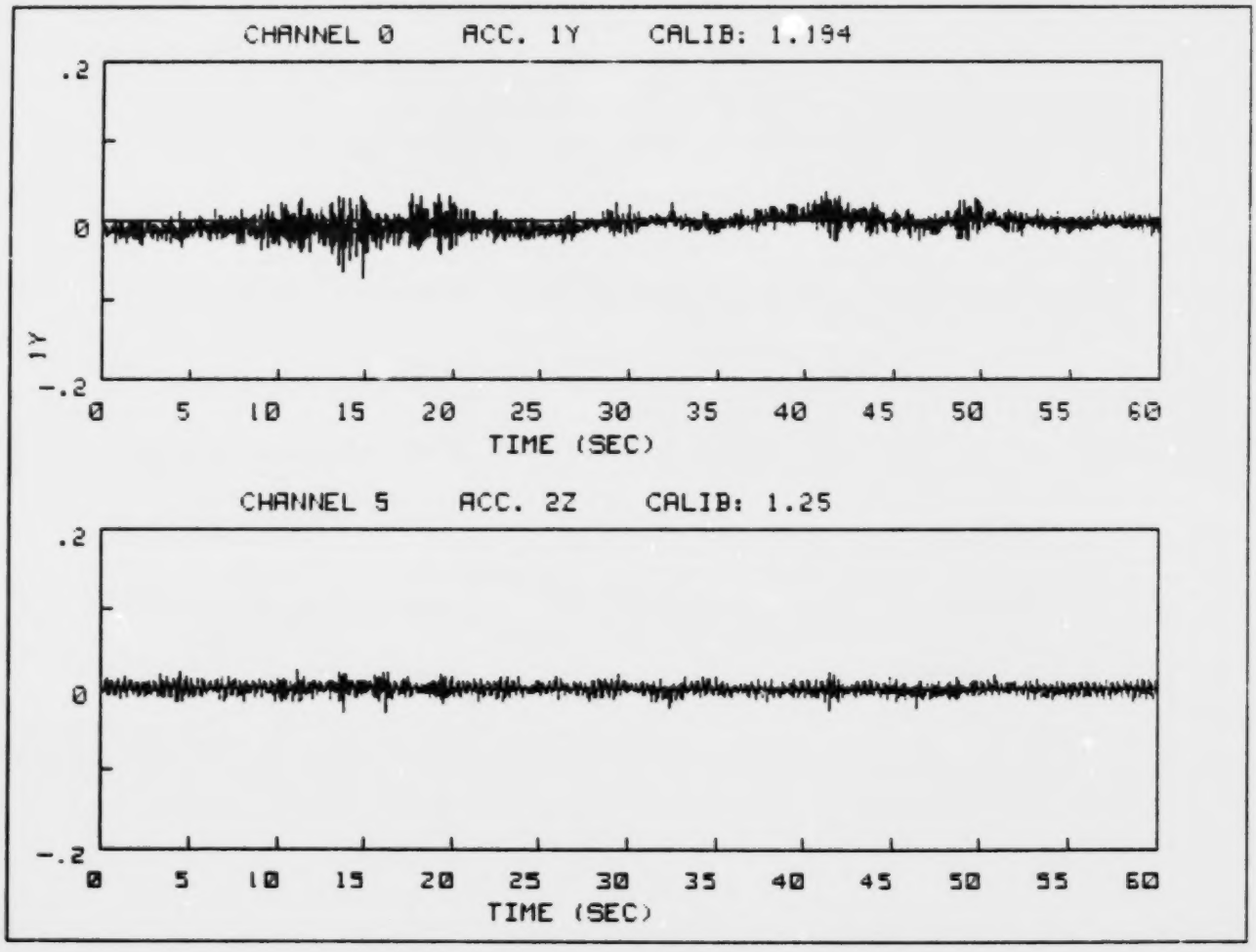
USCGC POLAR SEA -F.S. TEST TRANSIT RAMMING LEVEL ICE

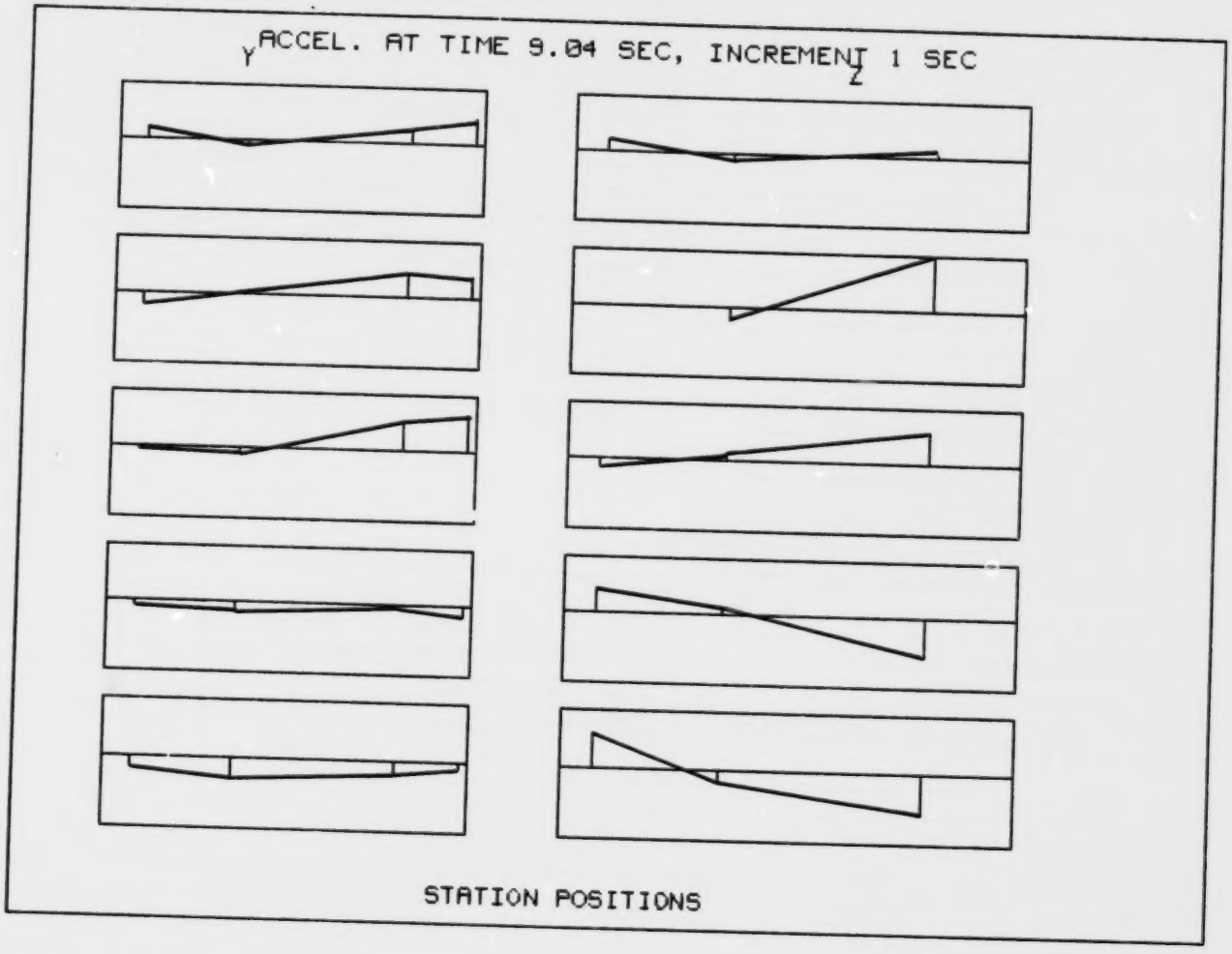
TEST CODE=F9-4 TEST DATE=FEB 9 1981 (13:50)

ICE TYPE=LEVEL ICE COVERAGE=100 % THICKNESS=3' max.

DIGITIZED DATE=09:04:12:02:51

PLOT STEP SIZE= 1




Y ACCEL. AT TIME 9.04 SEC, INCREMENT 1 SEC
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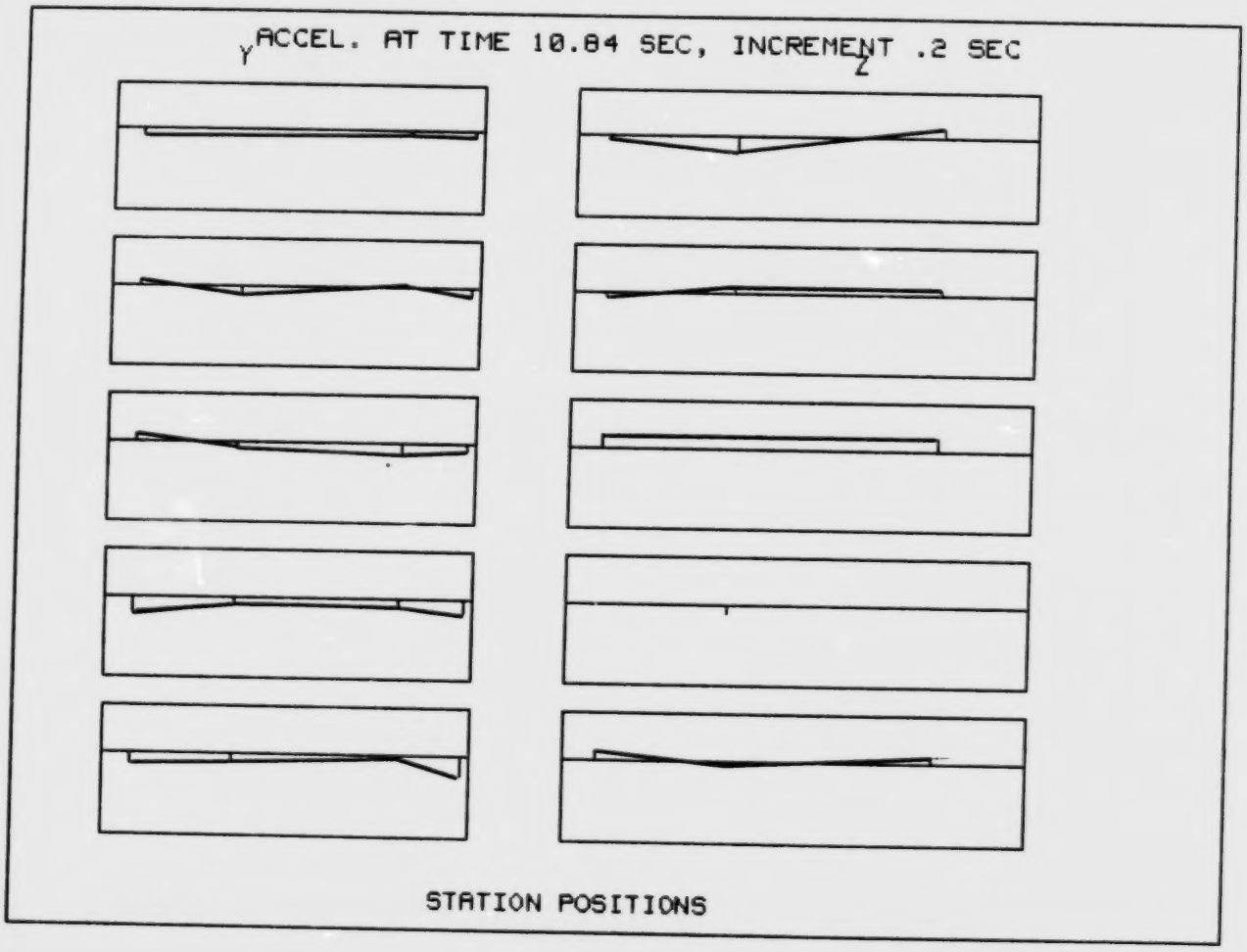
STATION POSITIONS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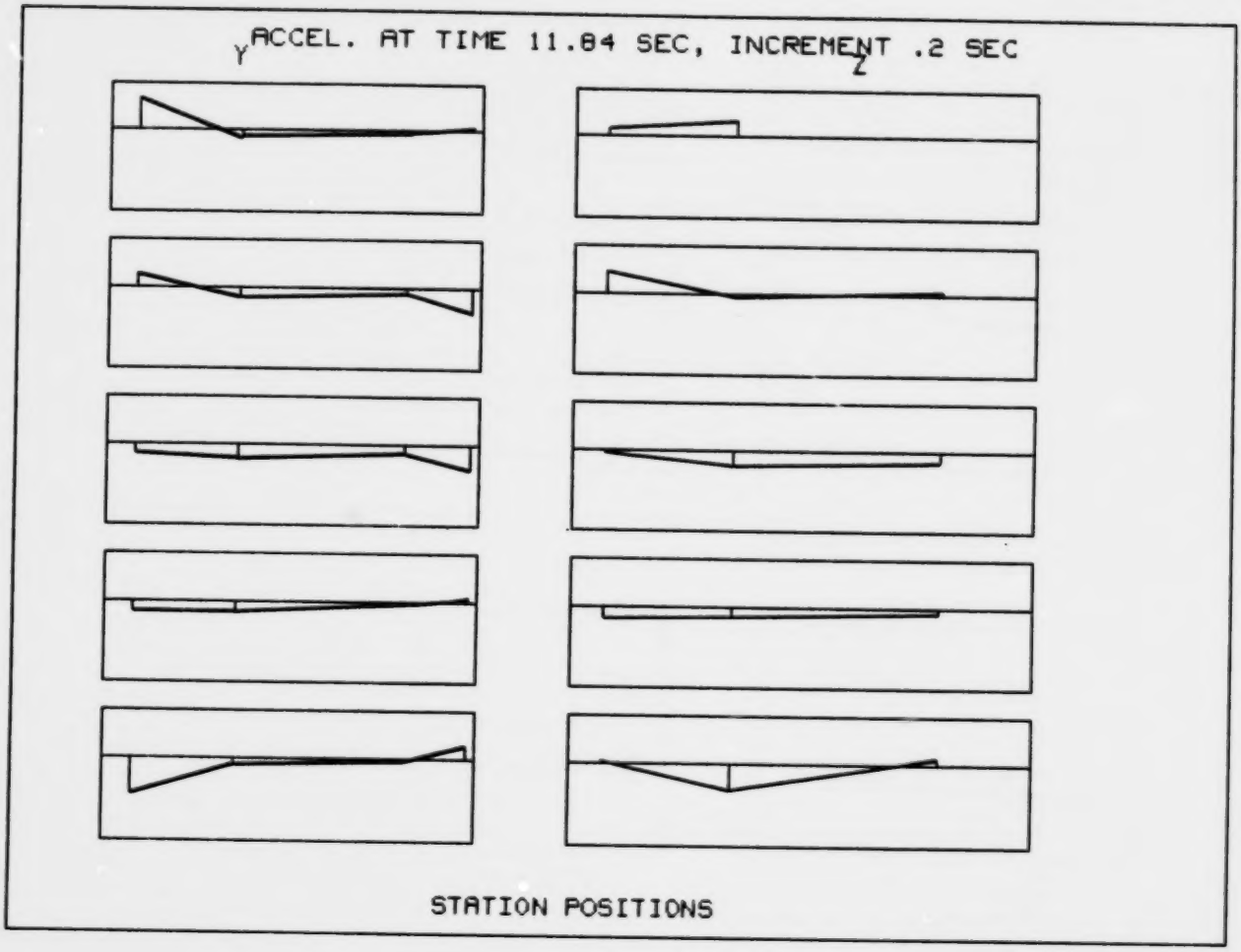
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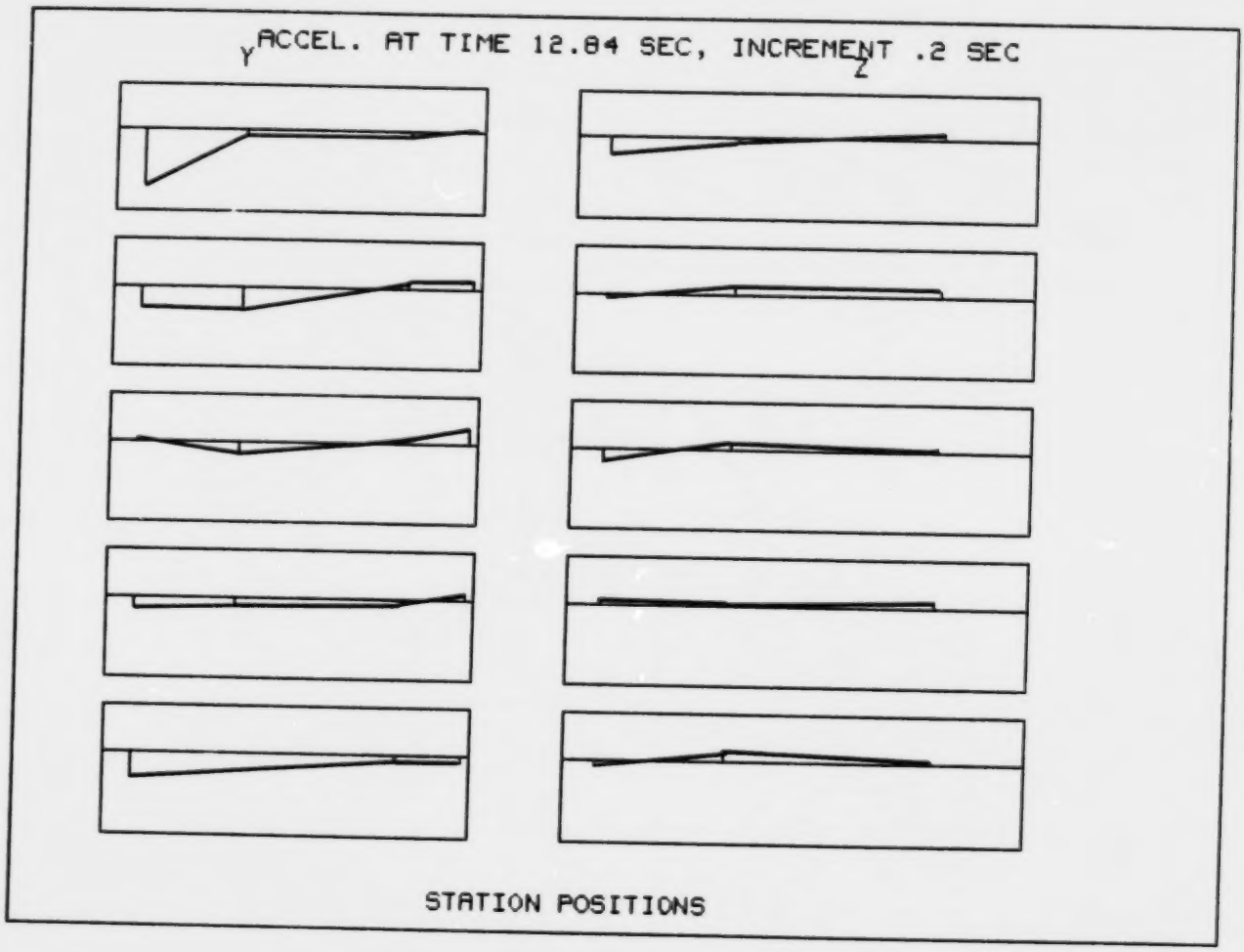
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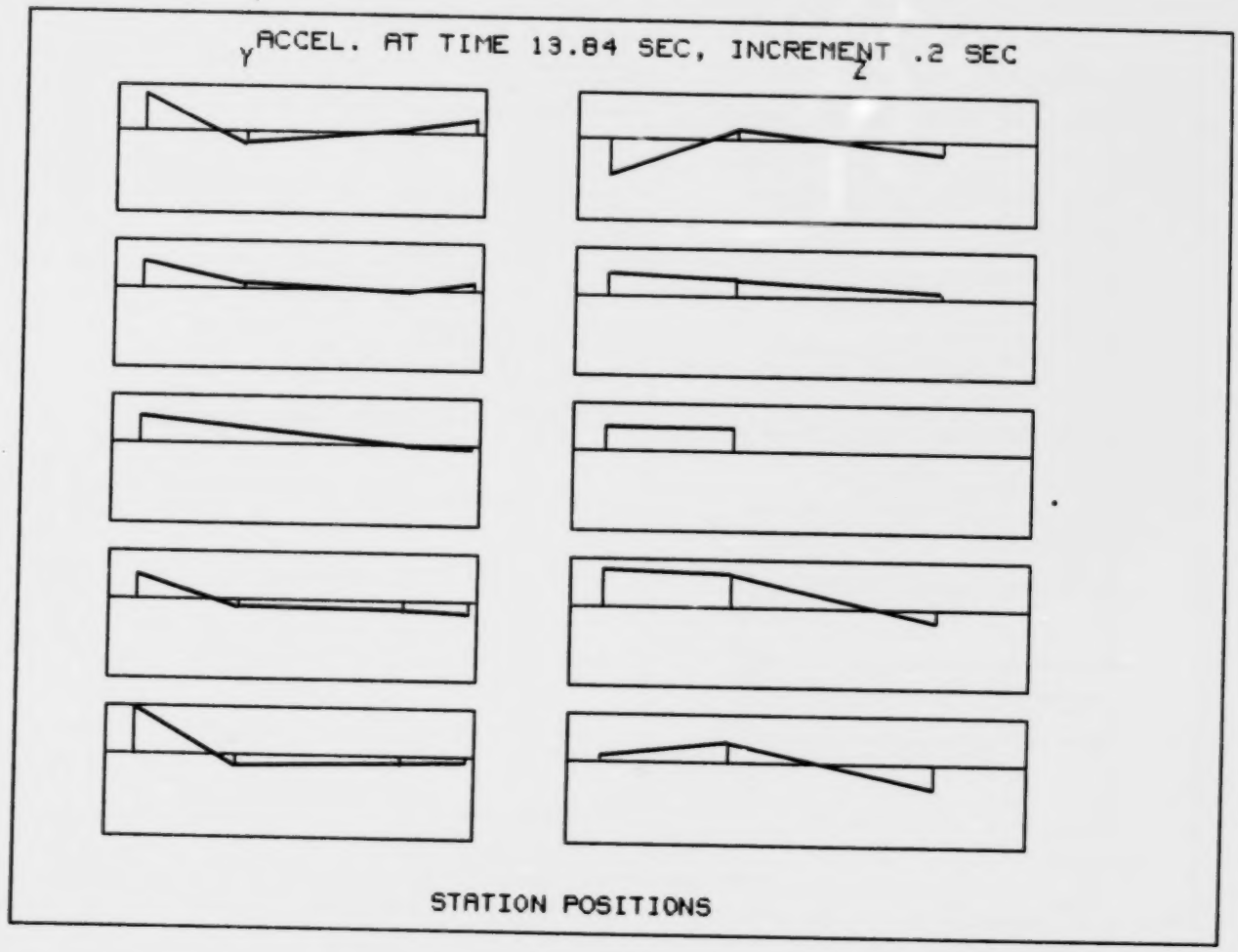
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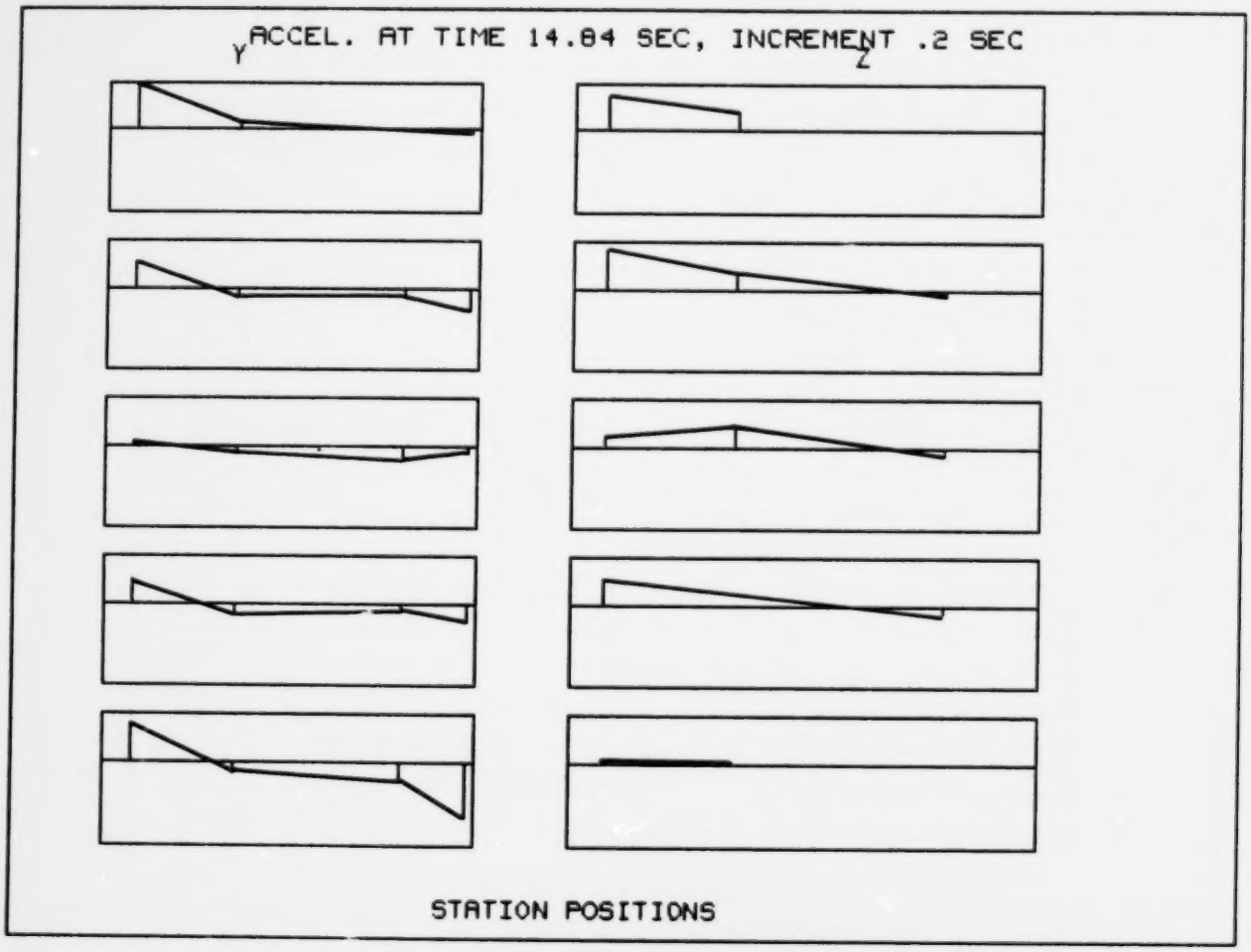
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USCGC POLAR SEA '81 TRIAL
RAMMING LEVEL ICE (02:09:14:00)
HEAD-ON, 4 Knots, MAX 3' ICE

ARCTEC CANADA
PLT464 - GRAPHICS

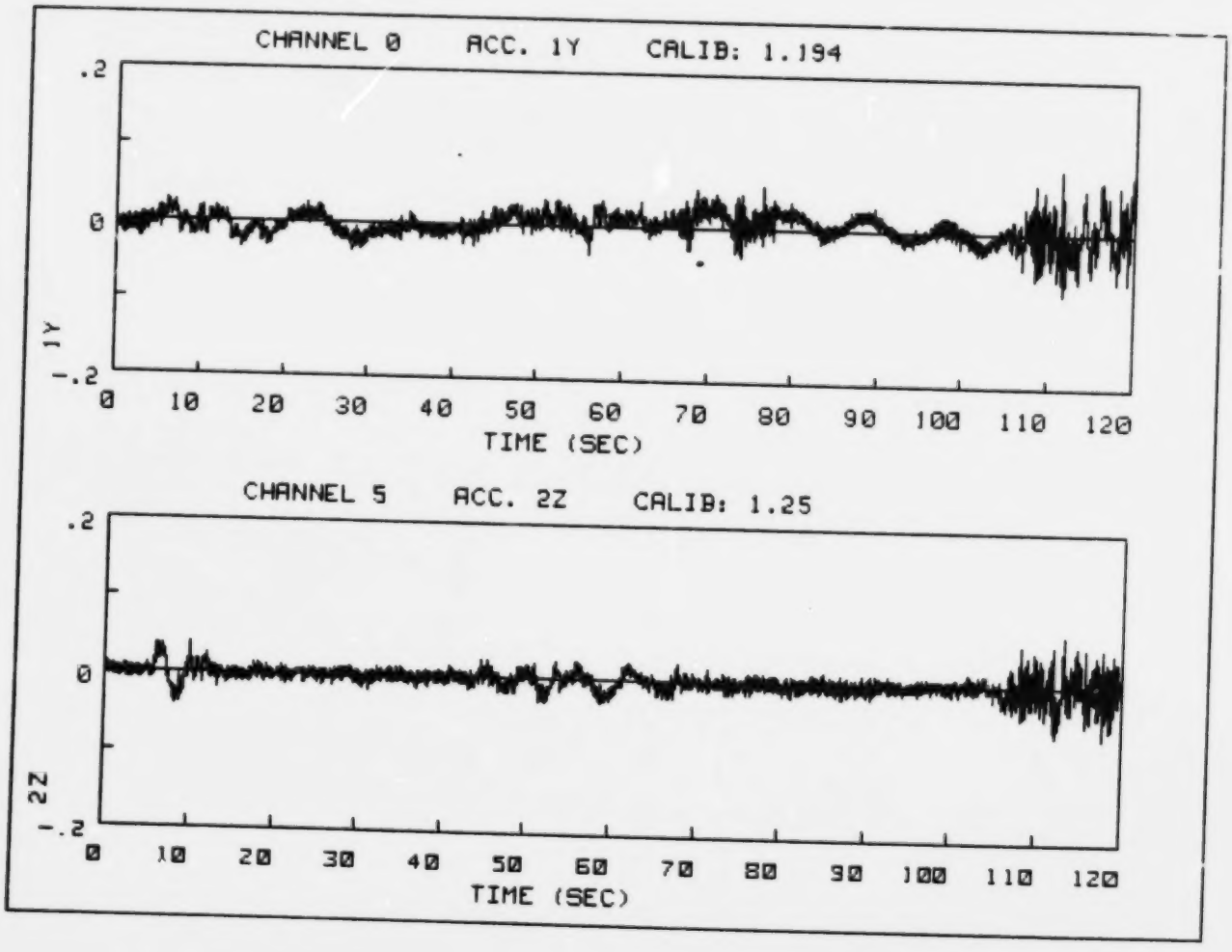
USCGC POLAR SEA -F.S. TEST RAMMING LEVEL ICE

TEST CODE=F9-5 TEST DATE= 1981 (14:00)

ICE TYPE=LEVEL ICE COVERAGE=100 % THICKNESS=3' max.

DIGITIZED DATE=09:04:11:28:38

PLOT STEP SIZE= 1



ARCTEC CANADA
PLT464 - GRAPHICS

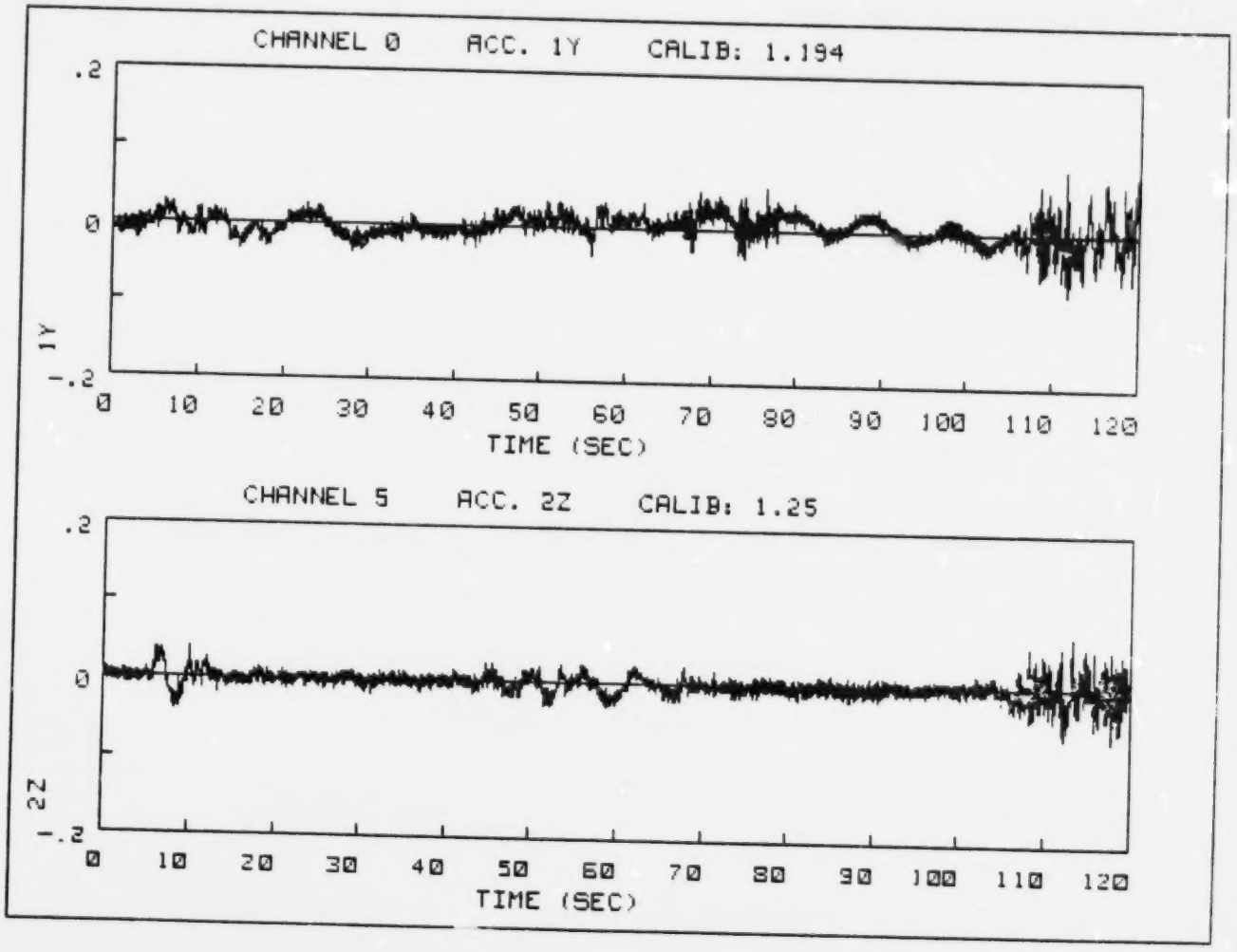
USCGC POLAR SEA -F.S. TEST RAMMING LEVEL ICE

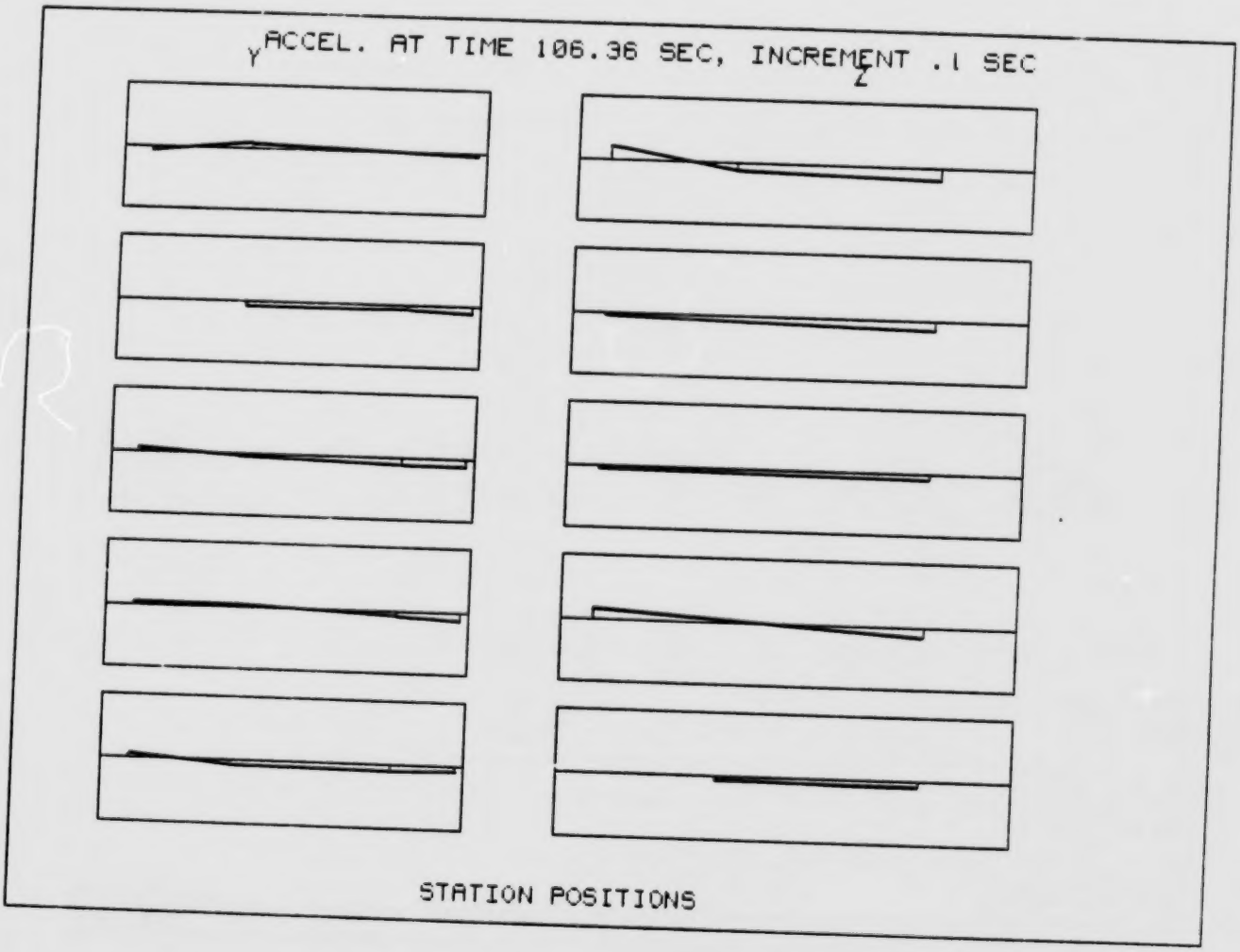
TEST CODE=F9-5 TEST DATE=FEB 9 1981 (14:00)

ICE TYPE=LEVEL ICE COVERAGE=100 % THICKNESS=3′ max.

DIGITIZED DATE=09:04:11:28:38

PLOT STEP SIZE= 1

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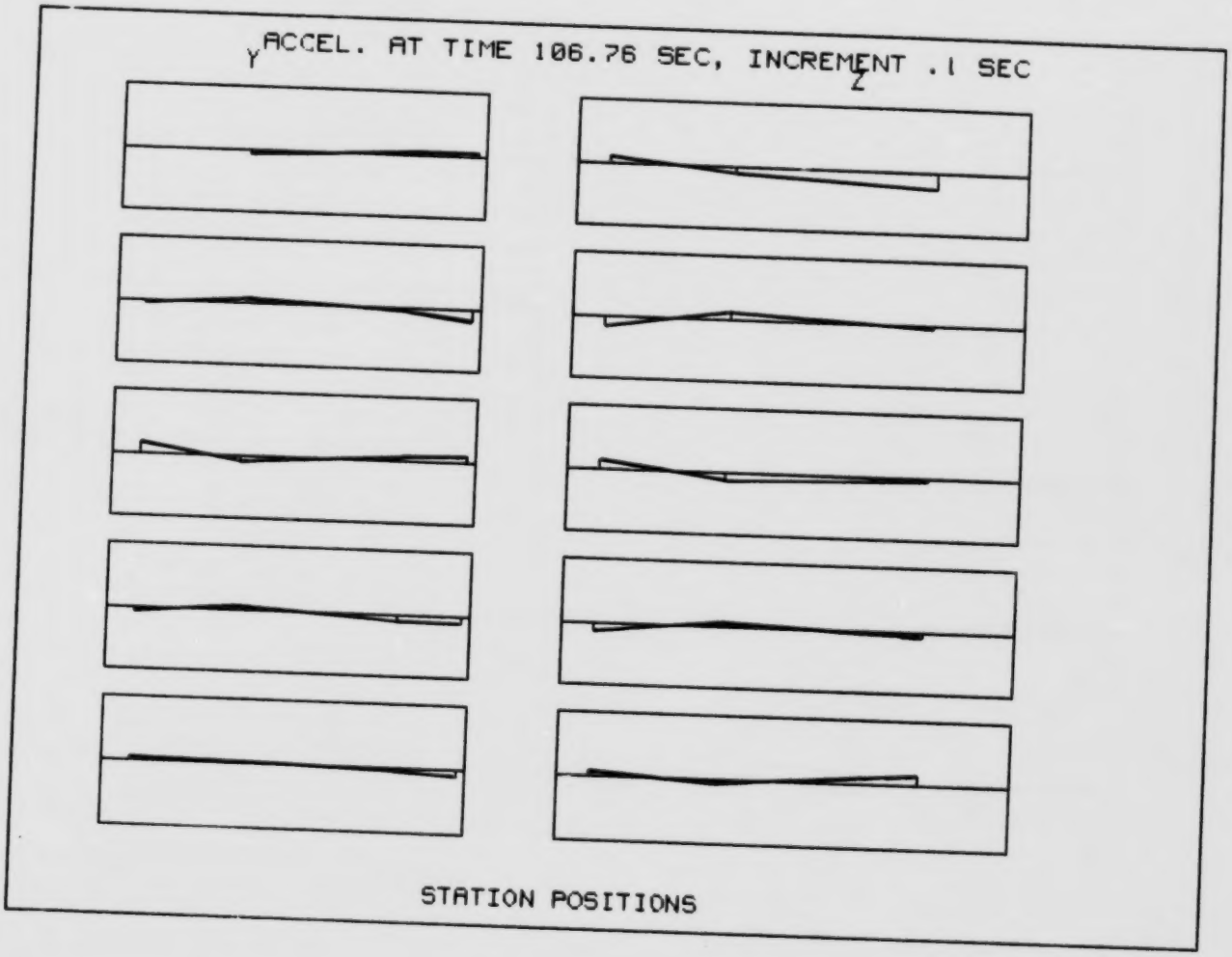
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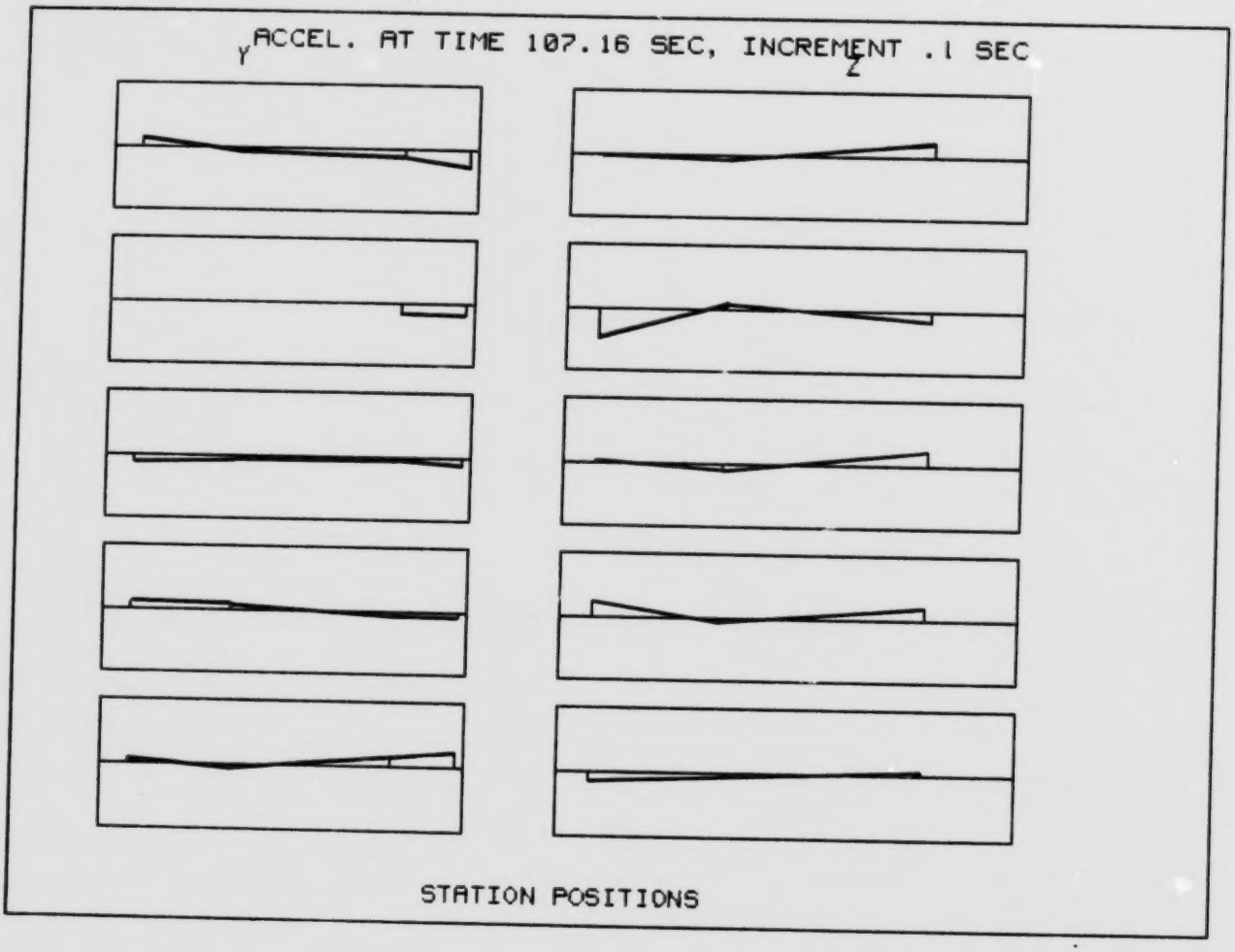
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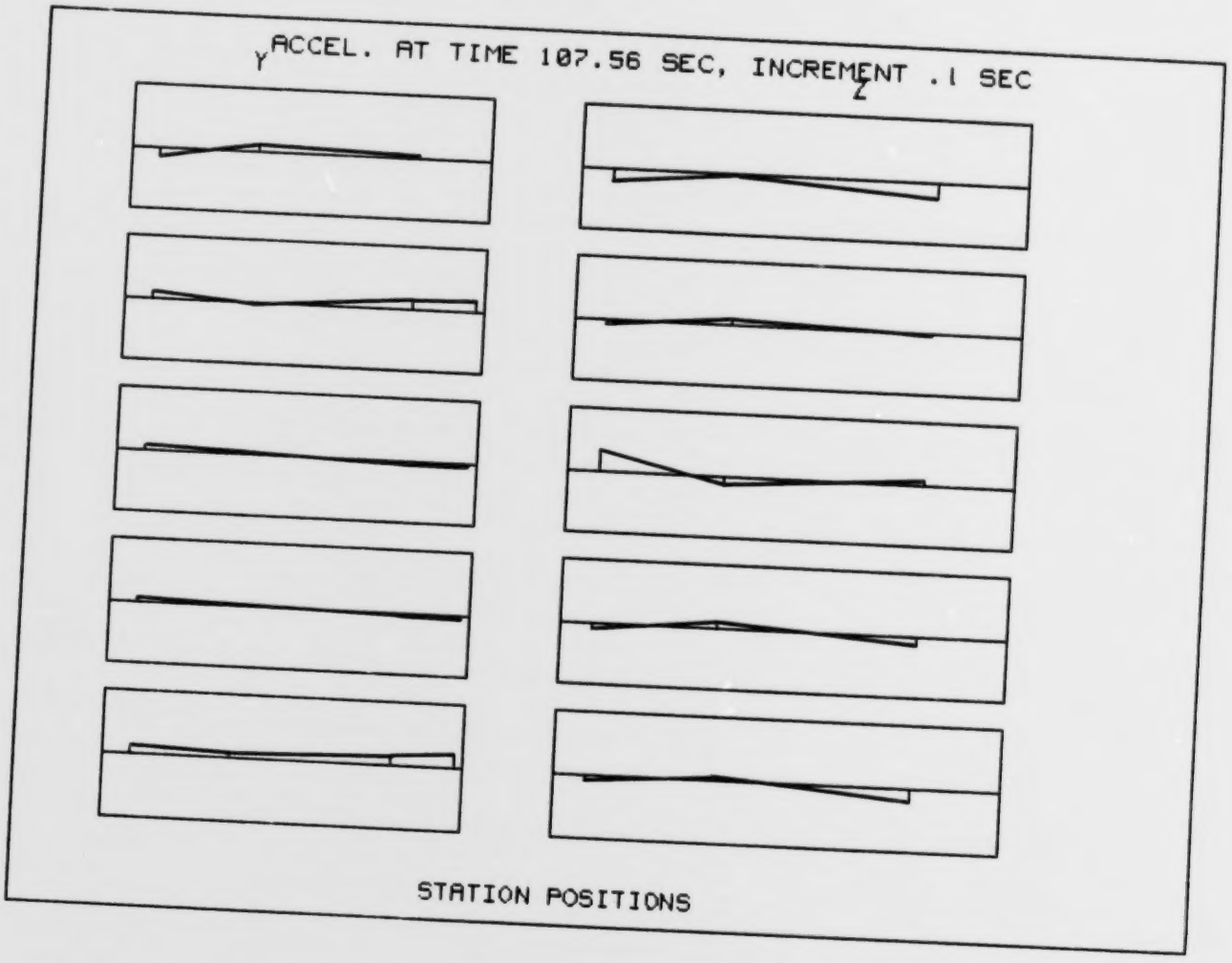
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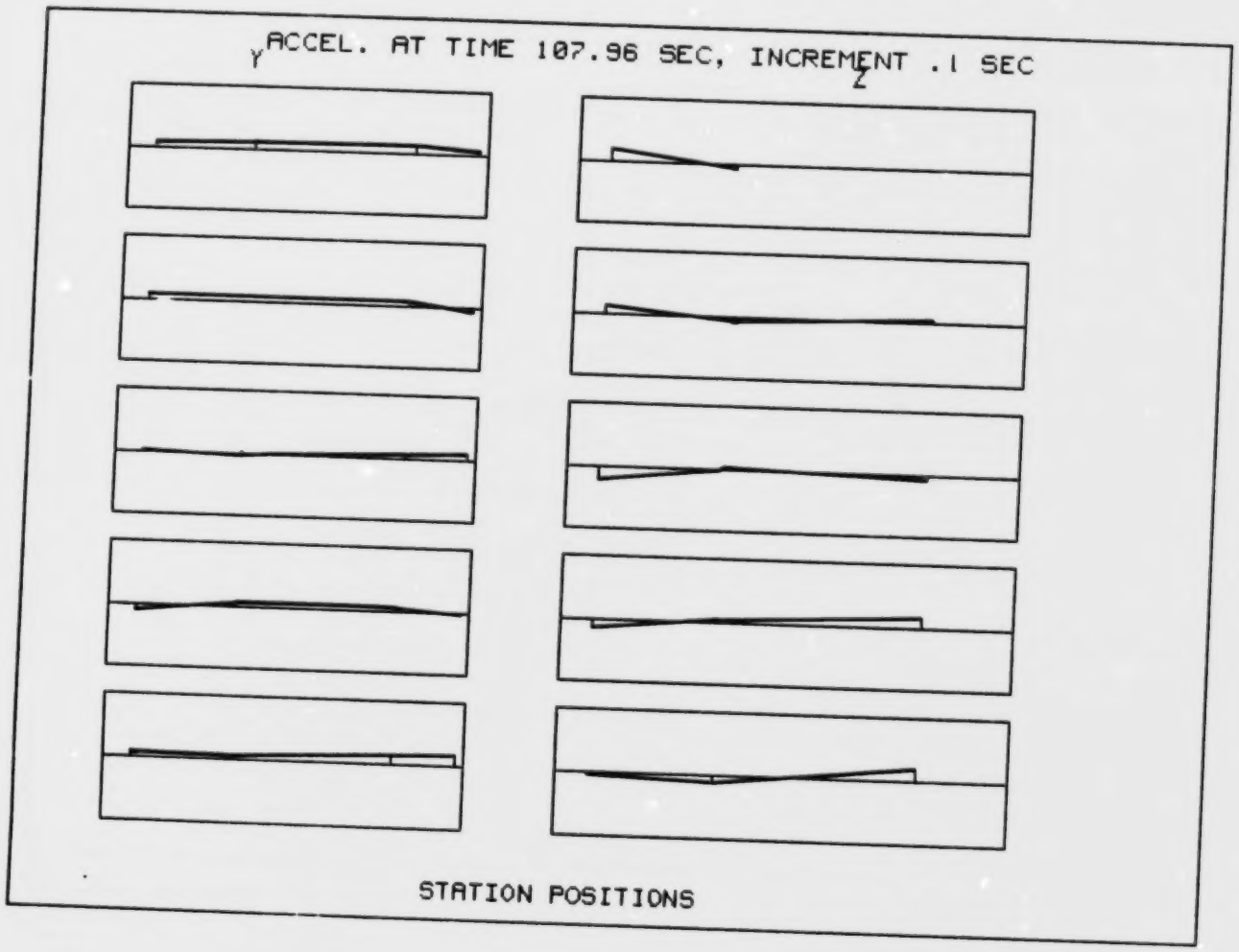
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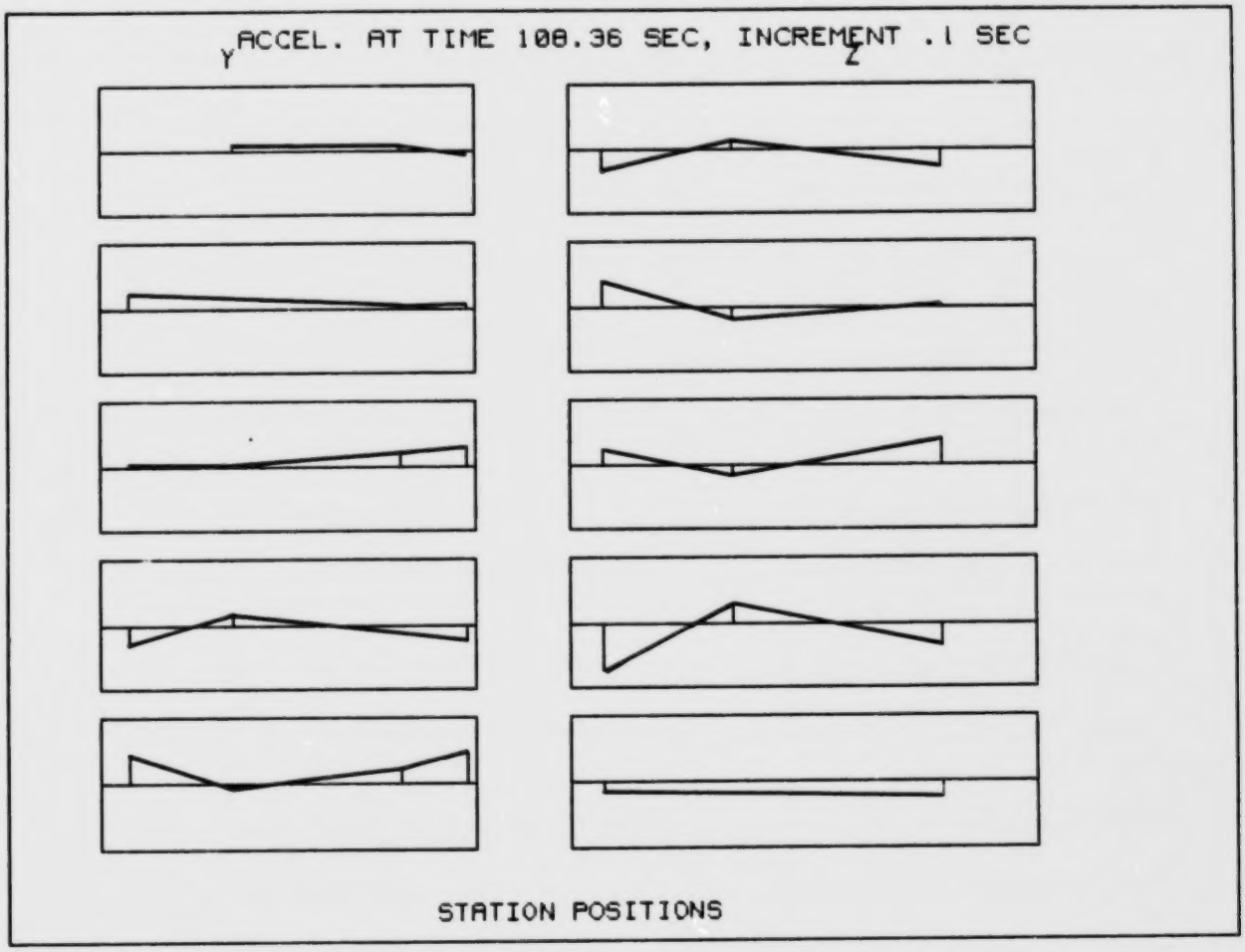
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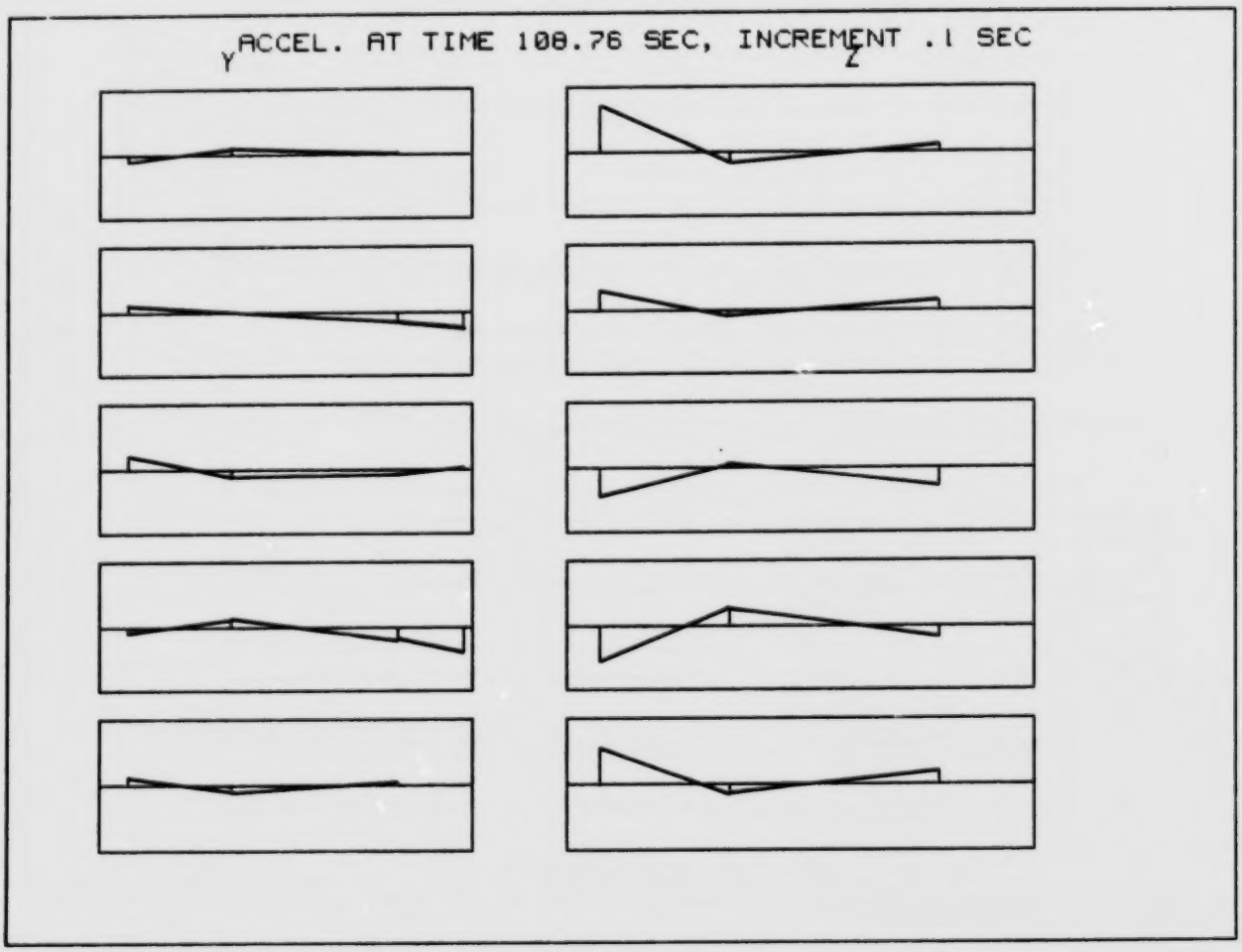
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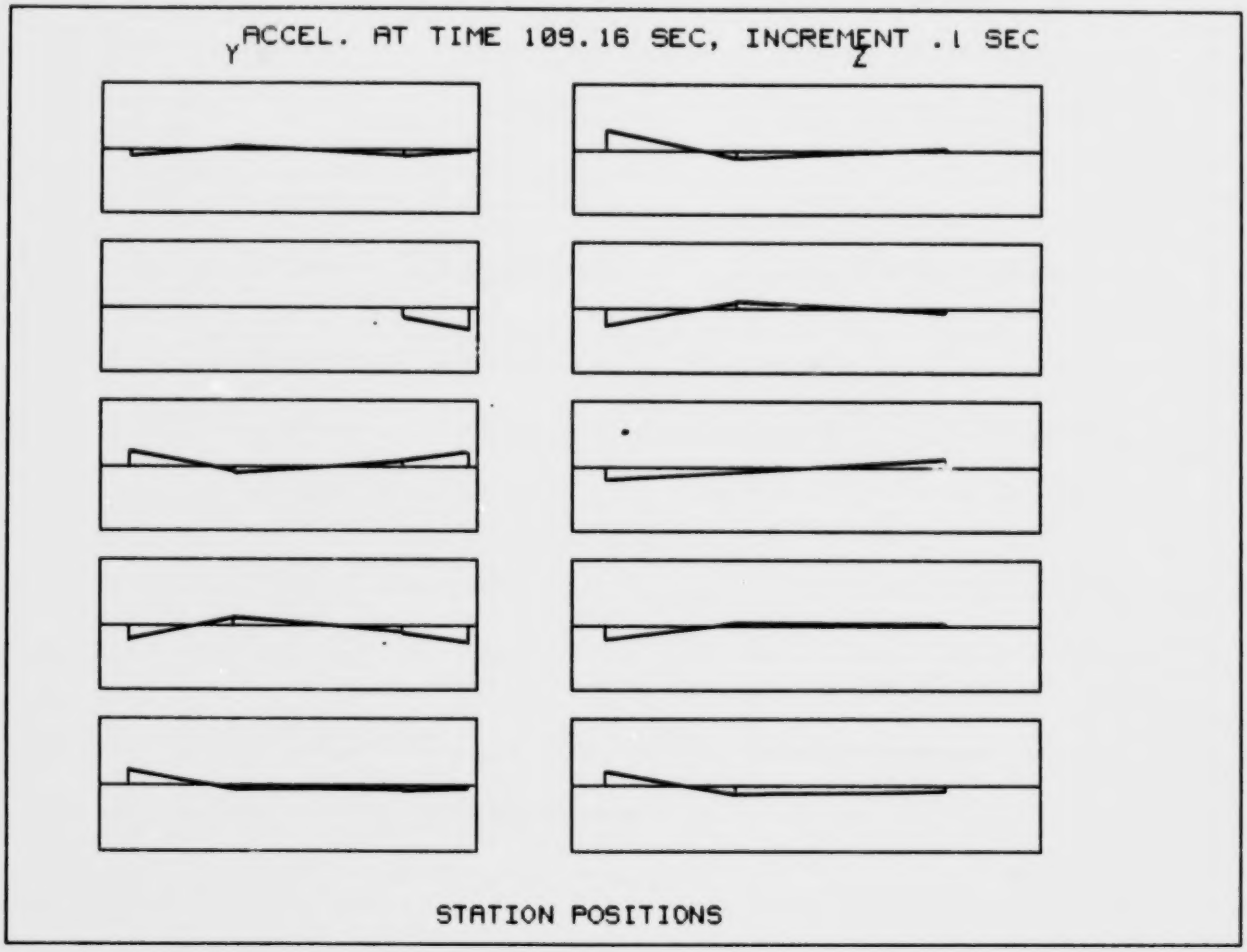
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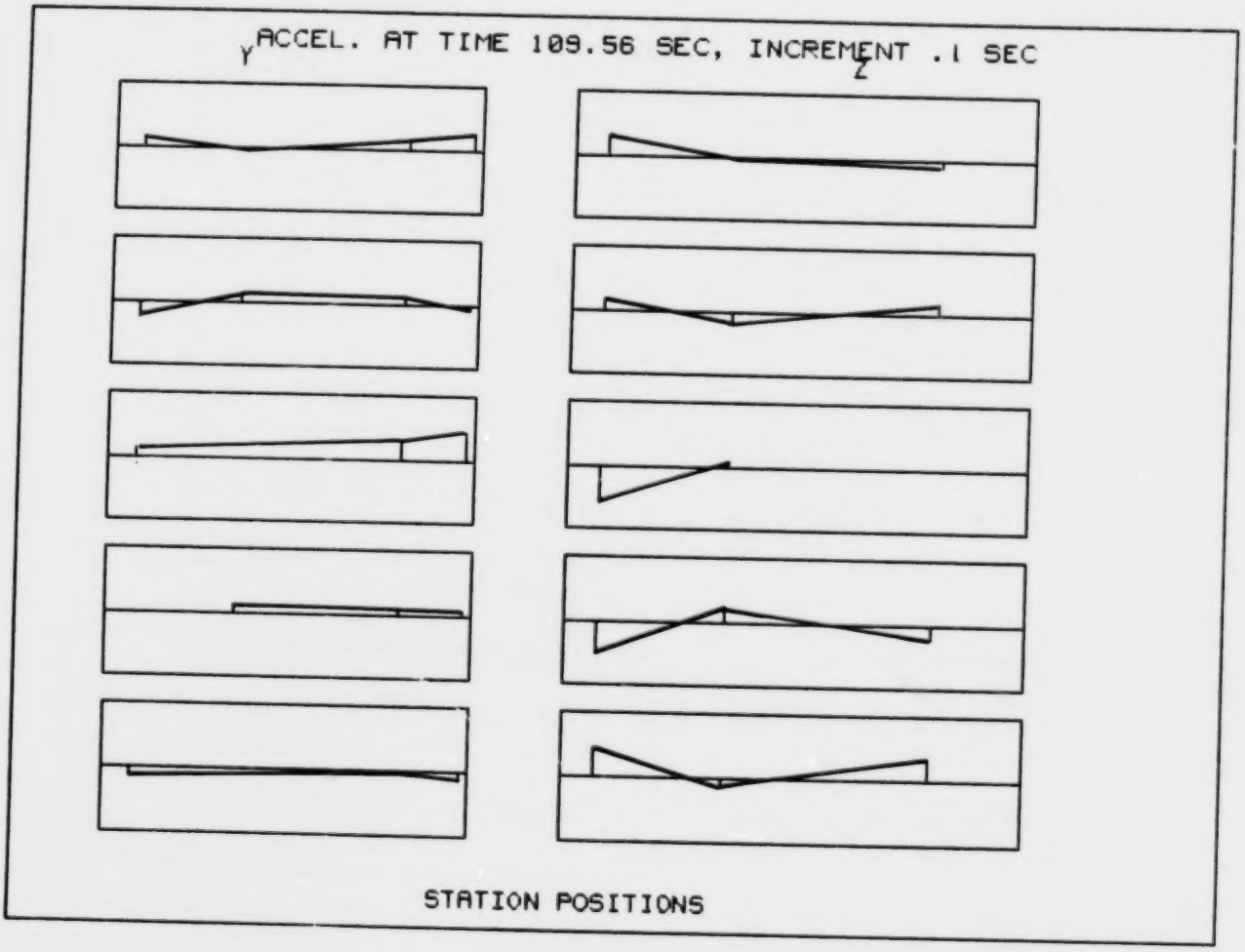
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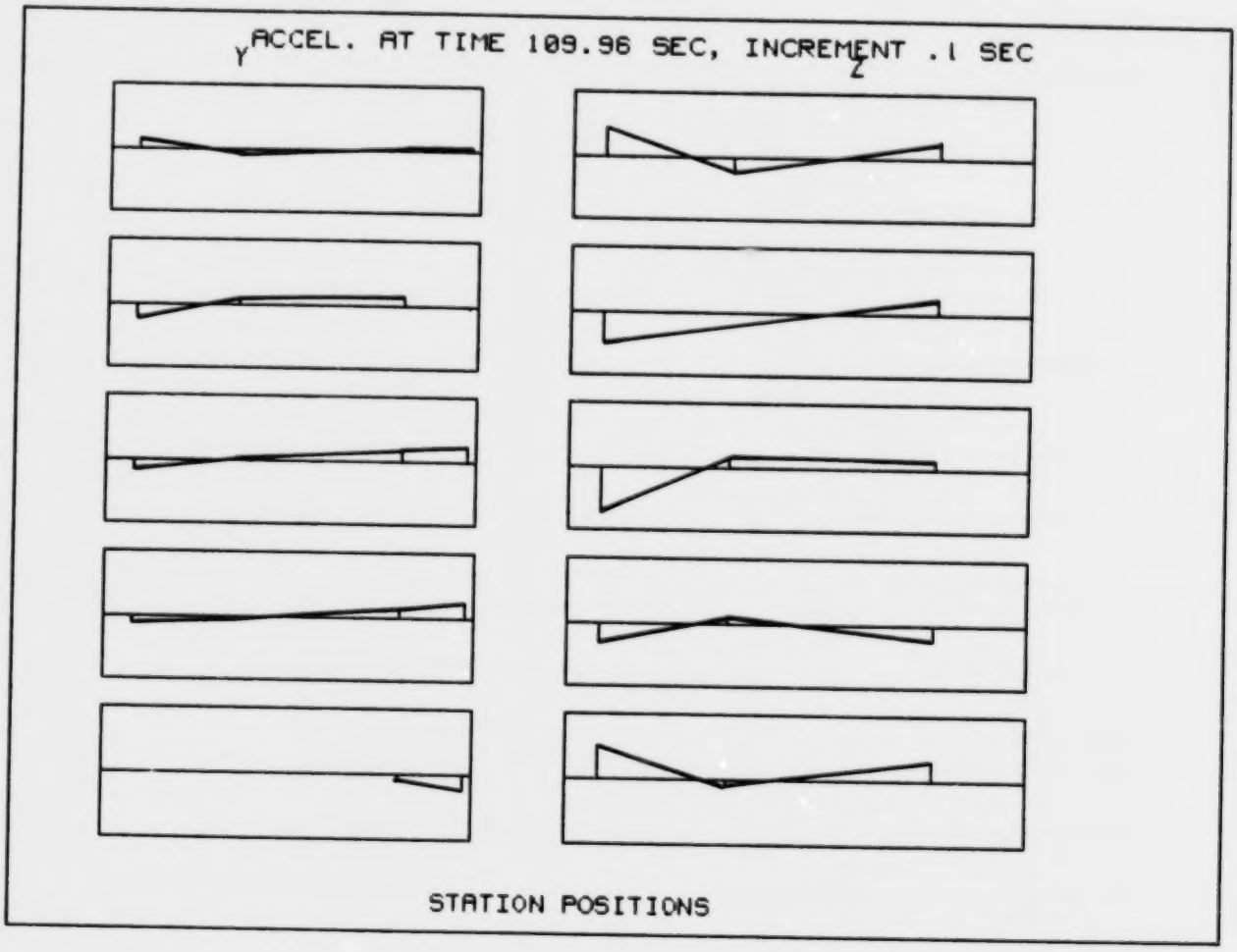
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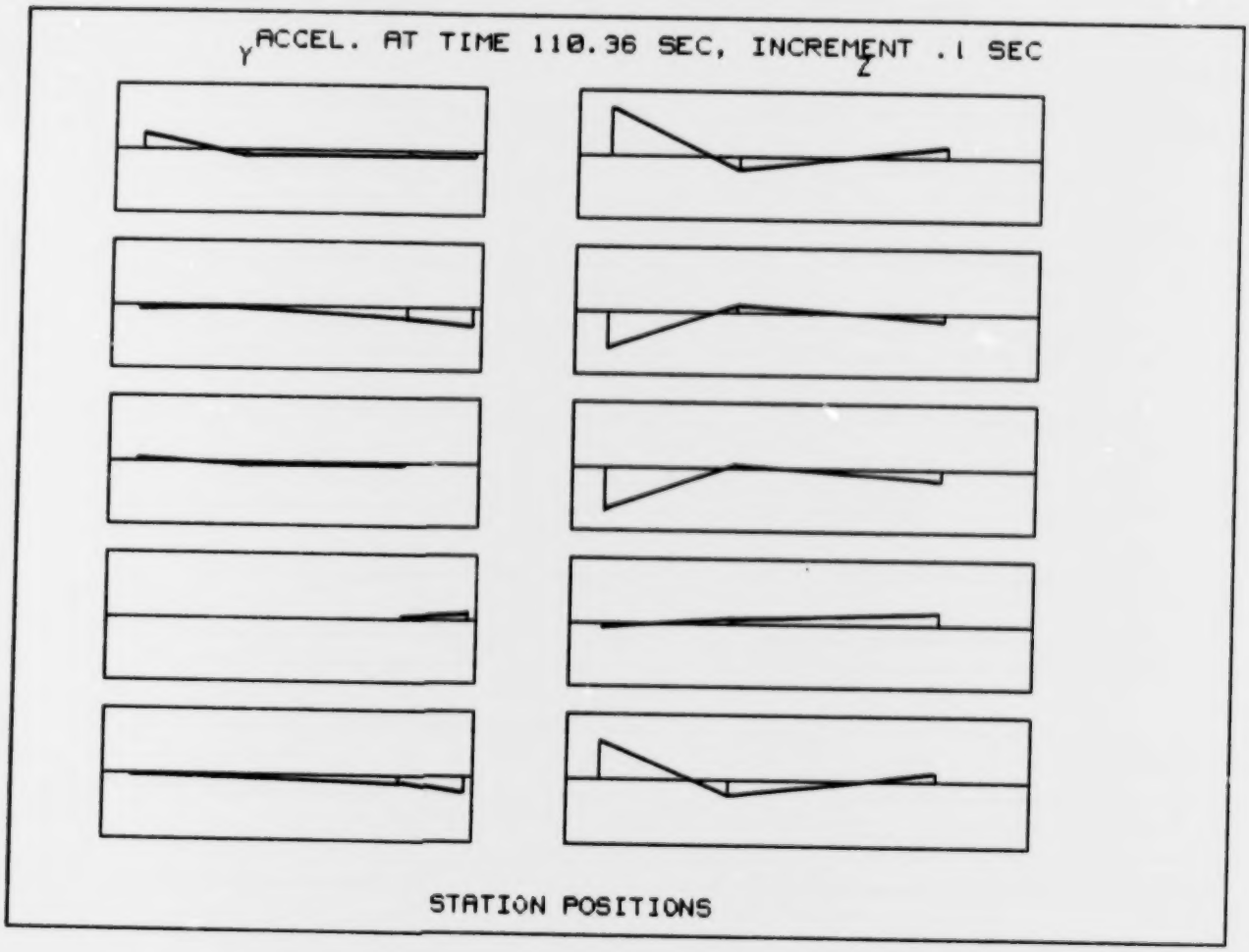
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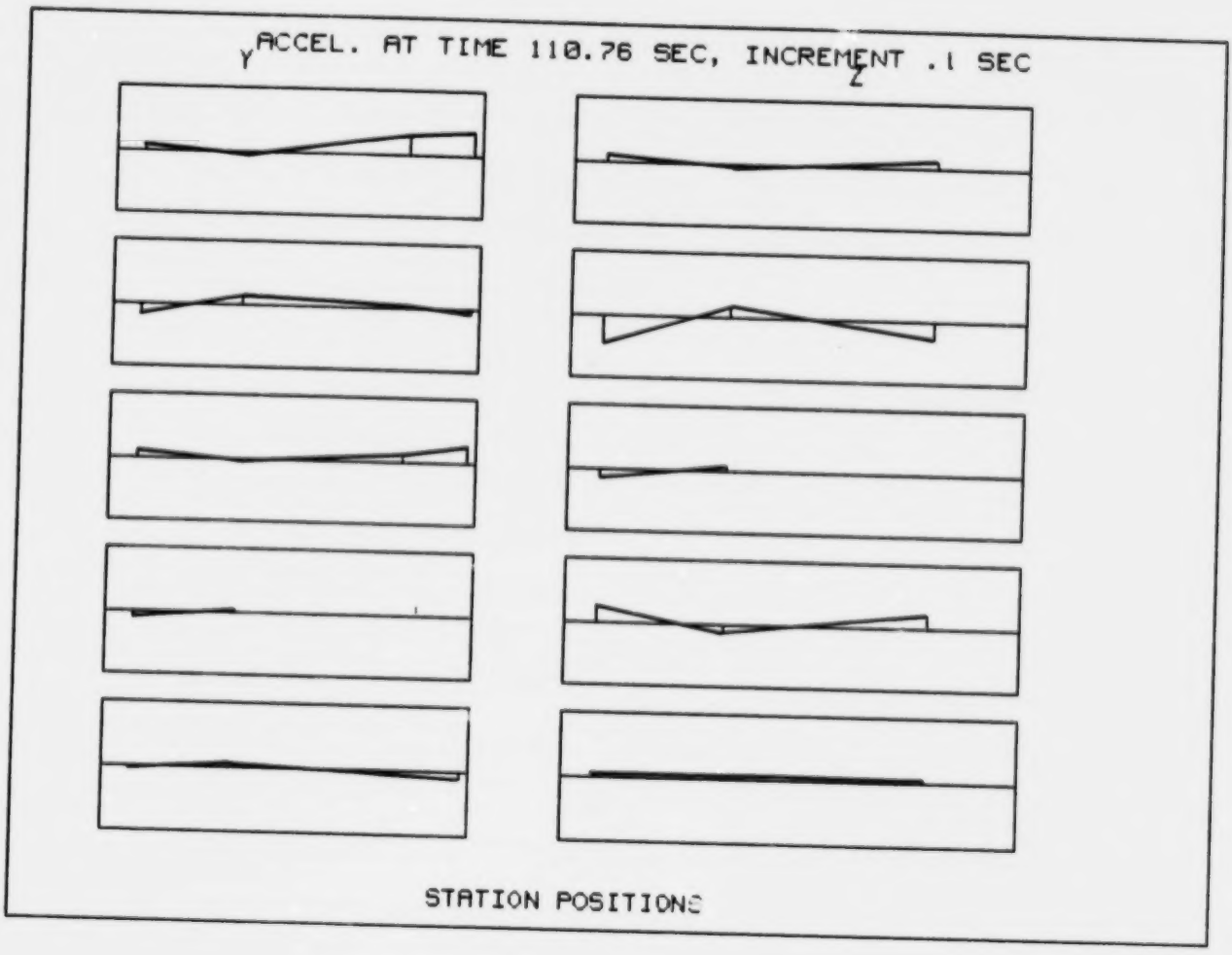
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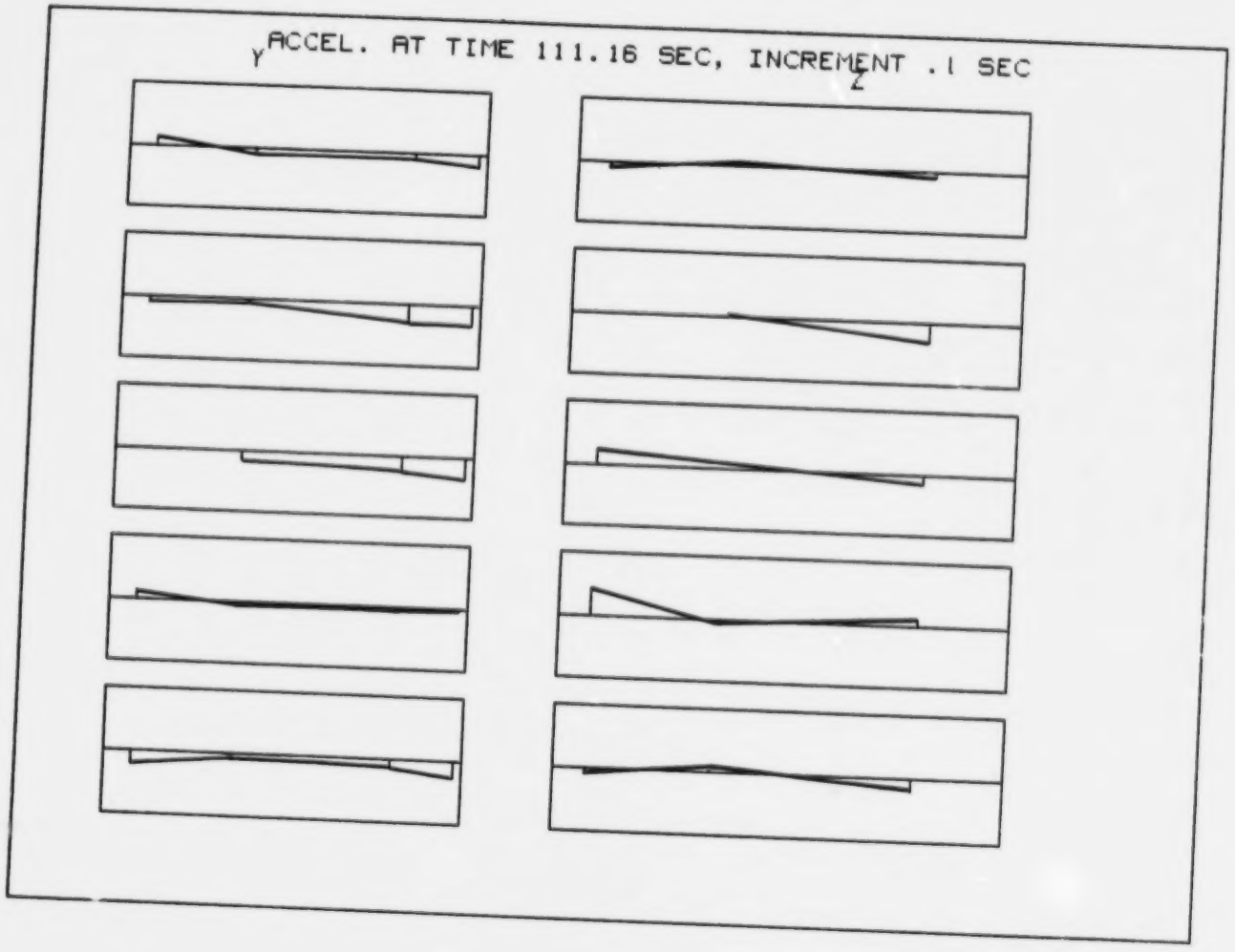
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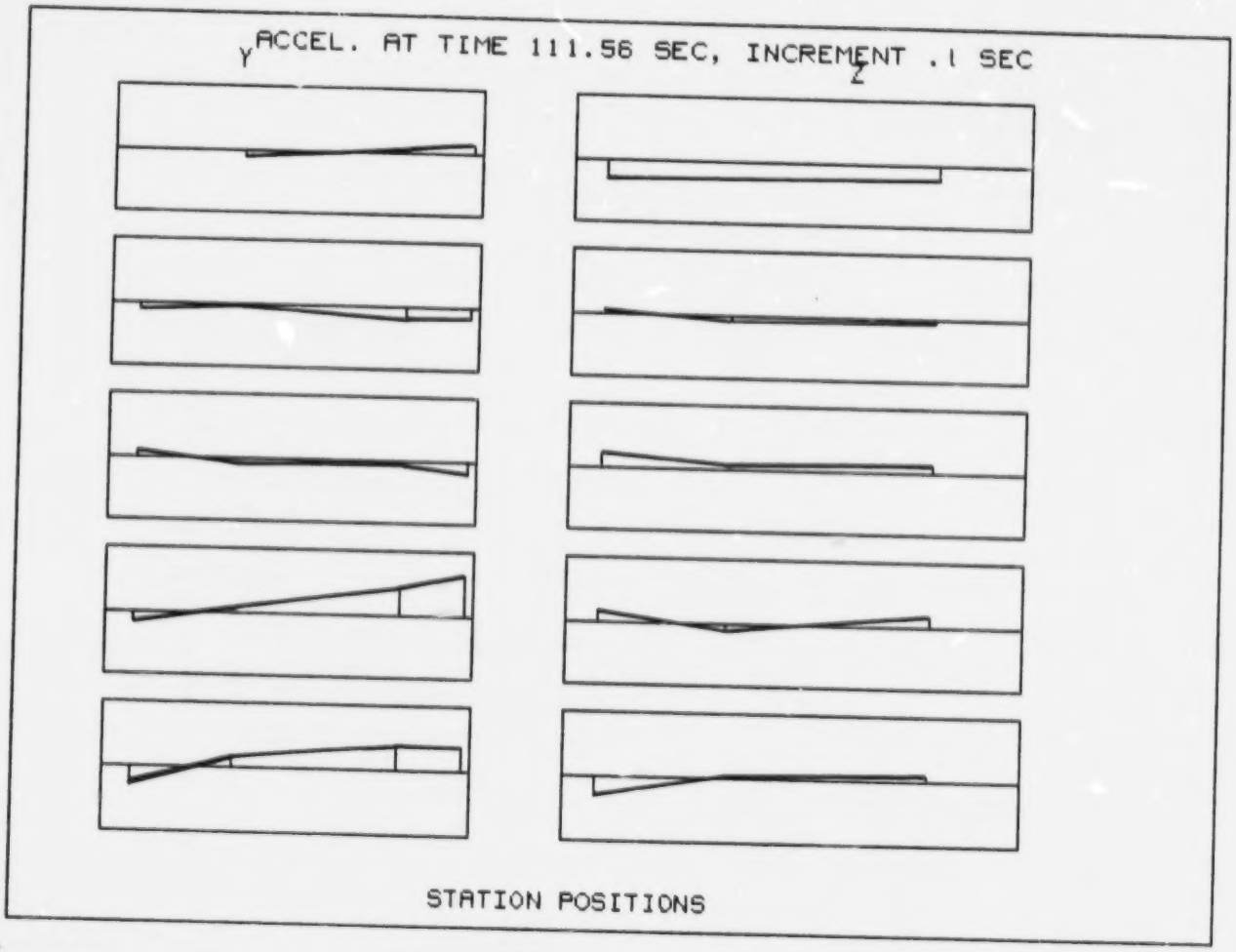
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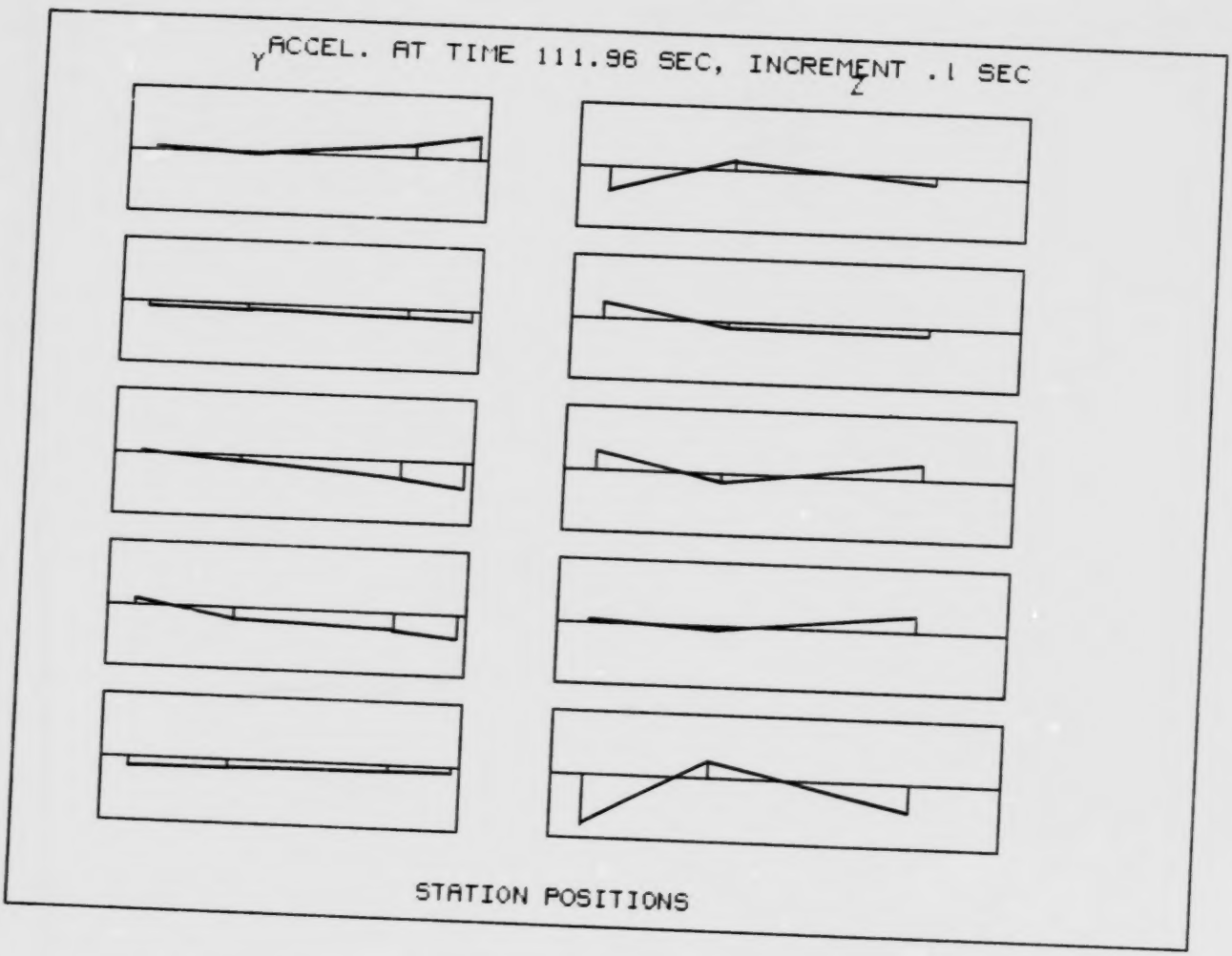
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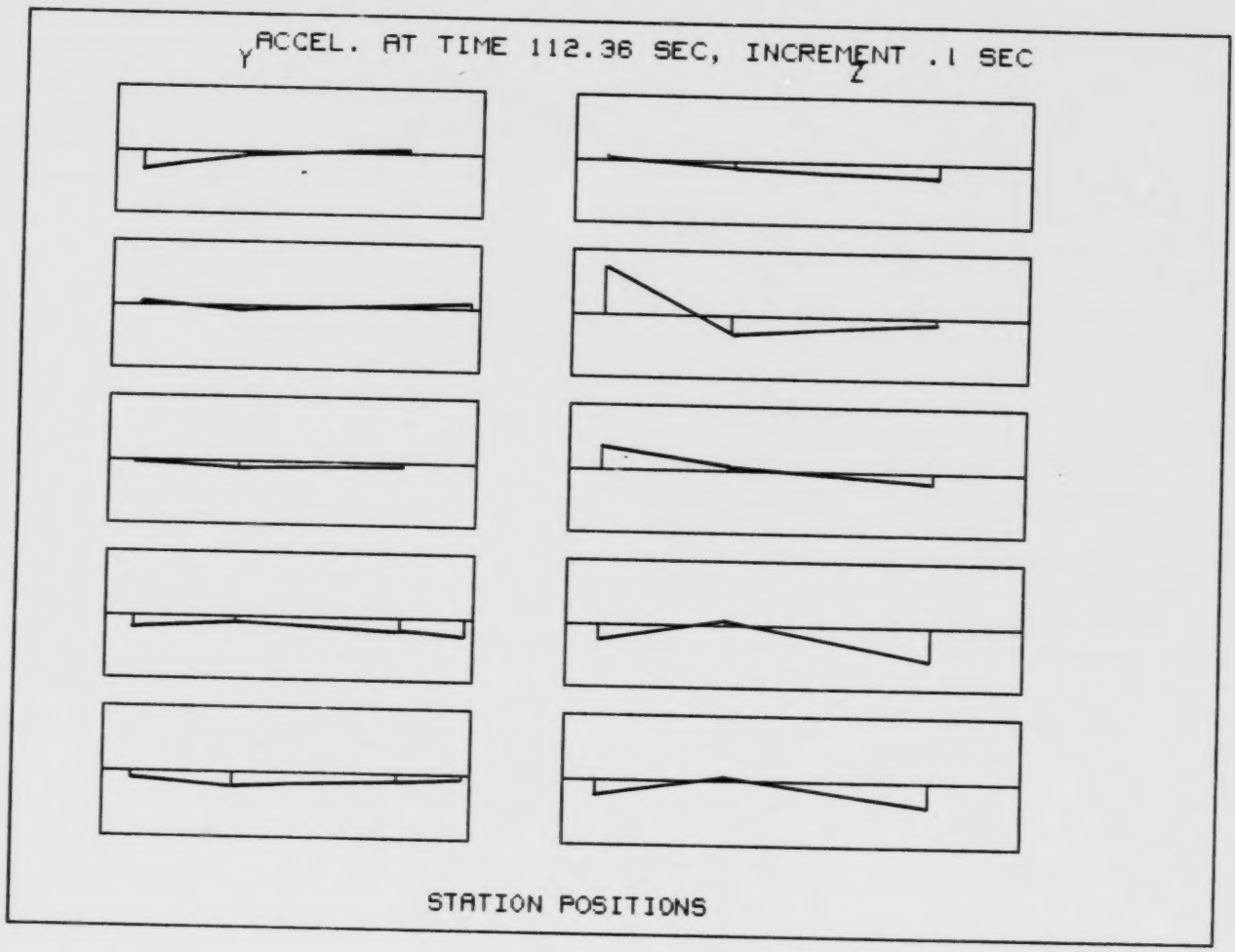
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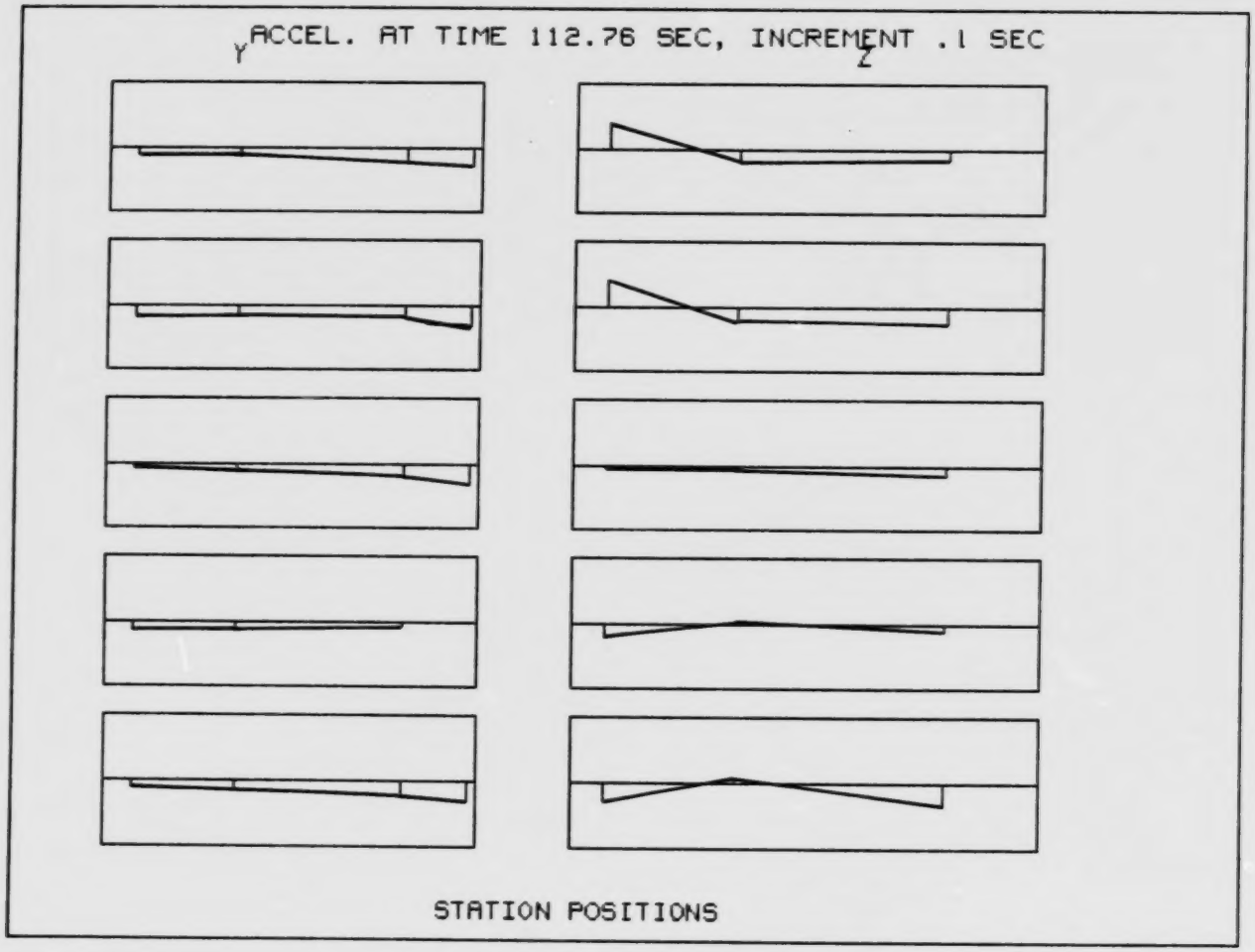
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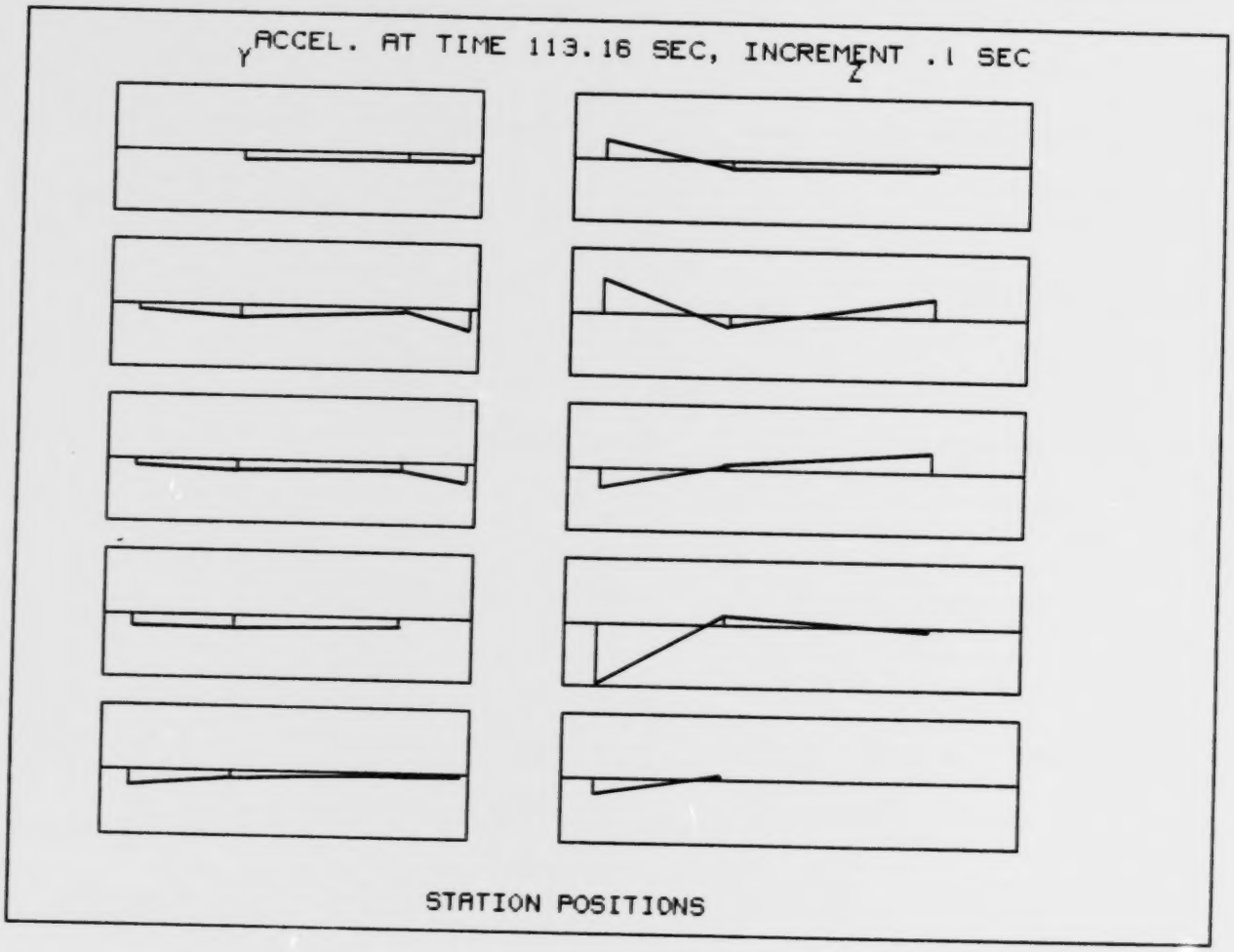
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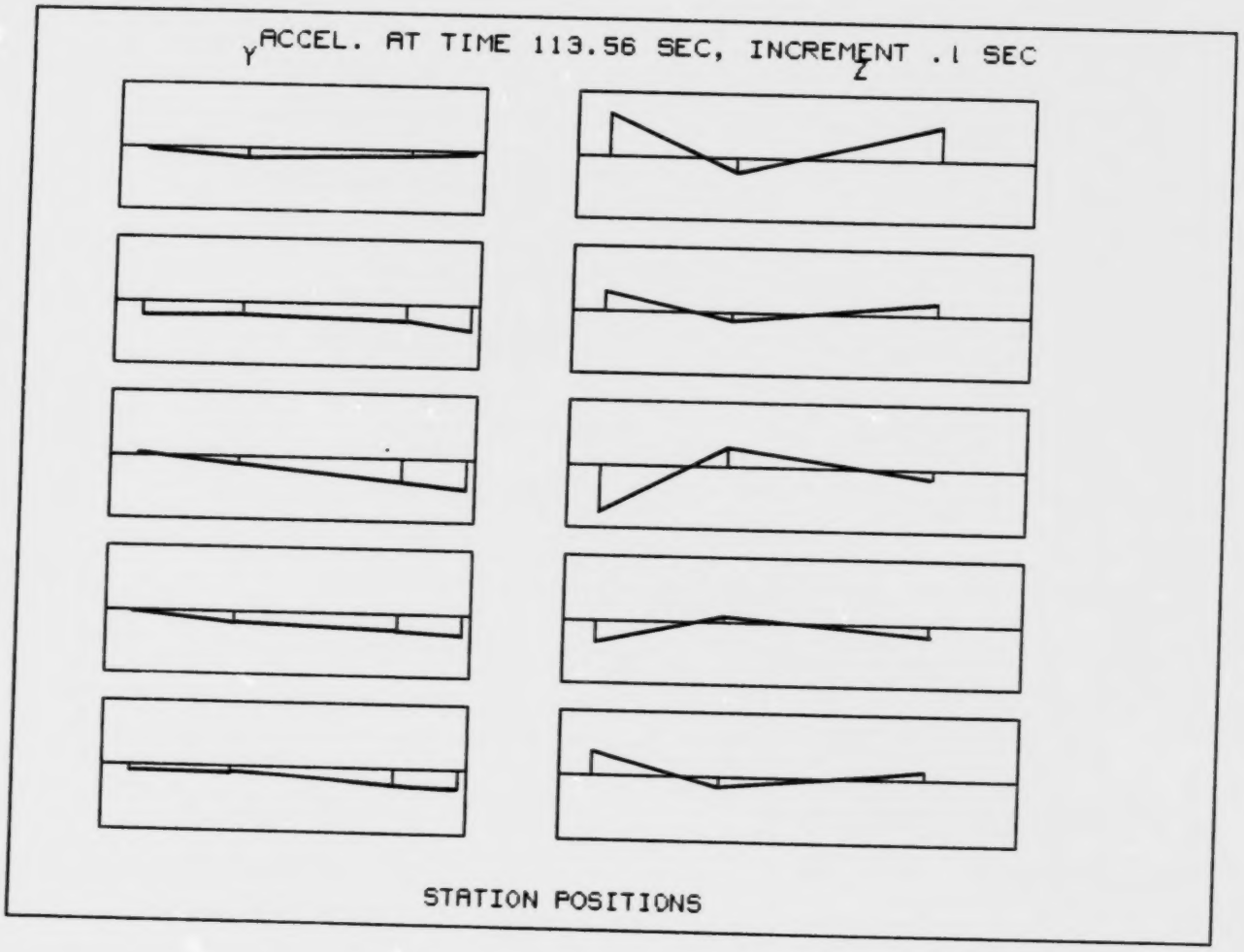
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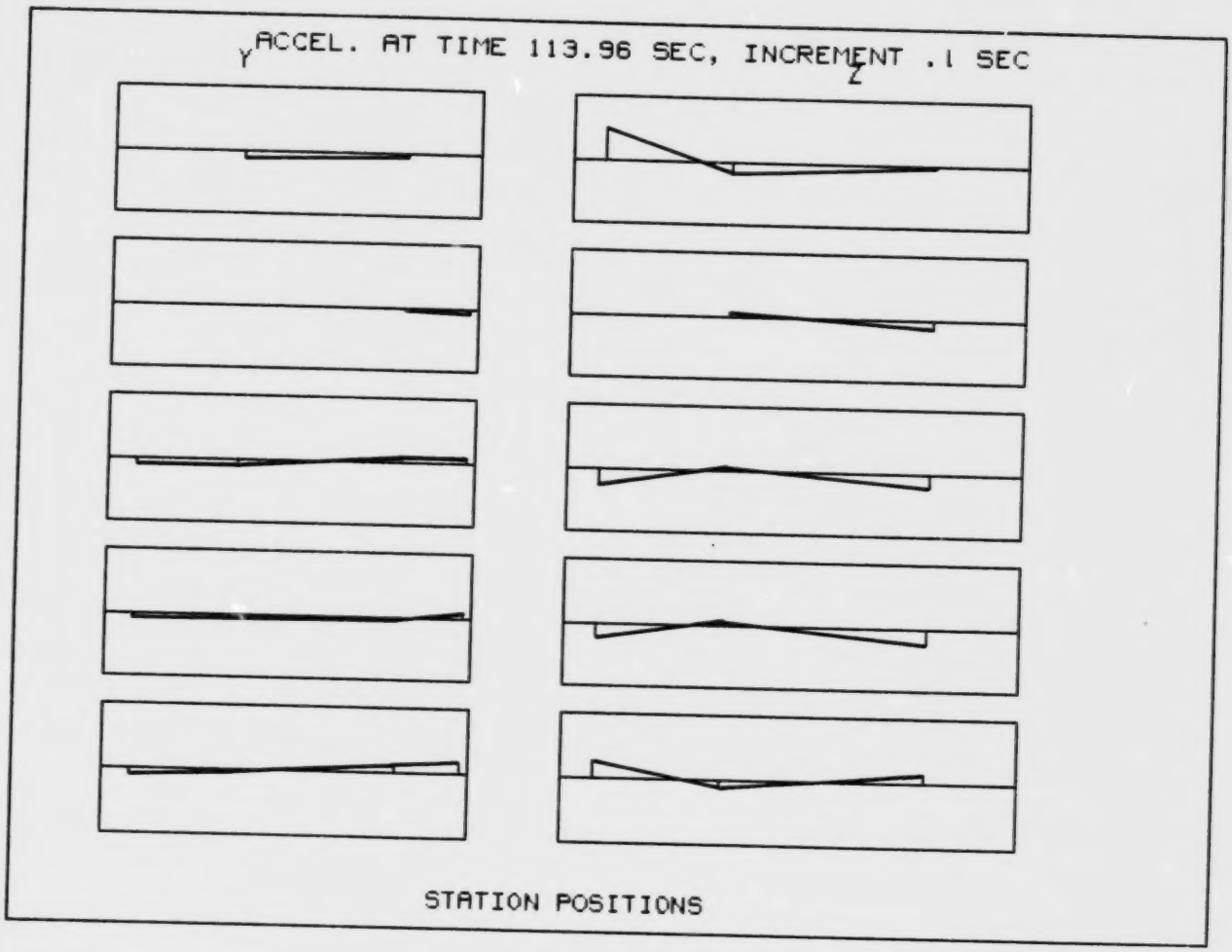
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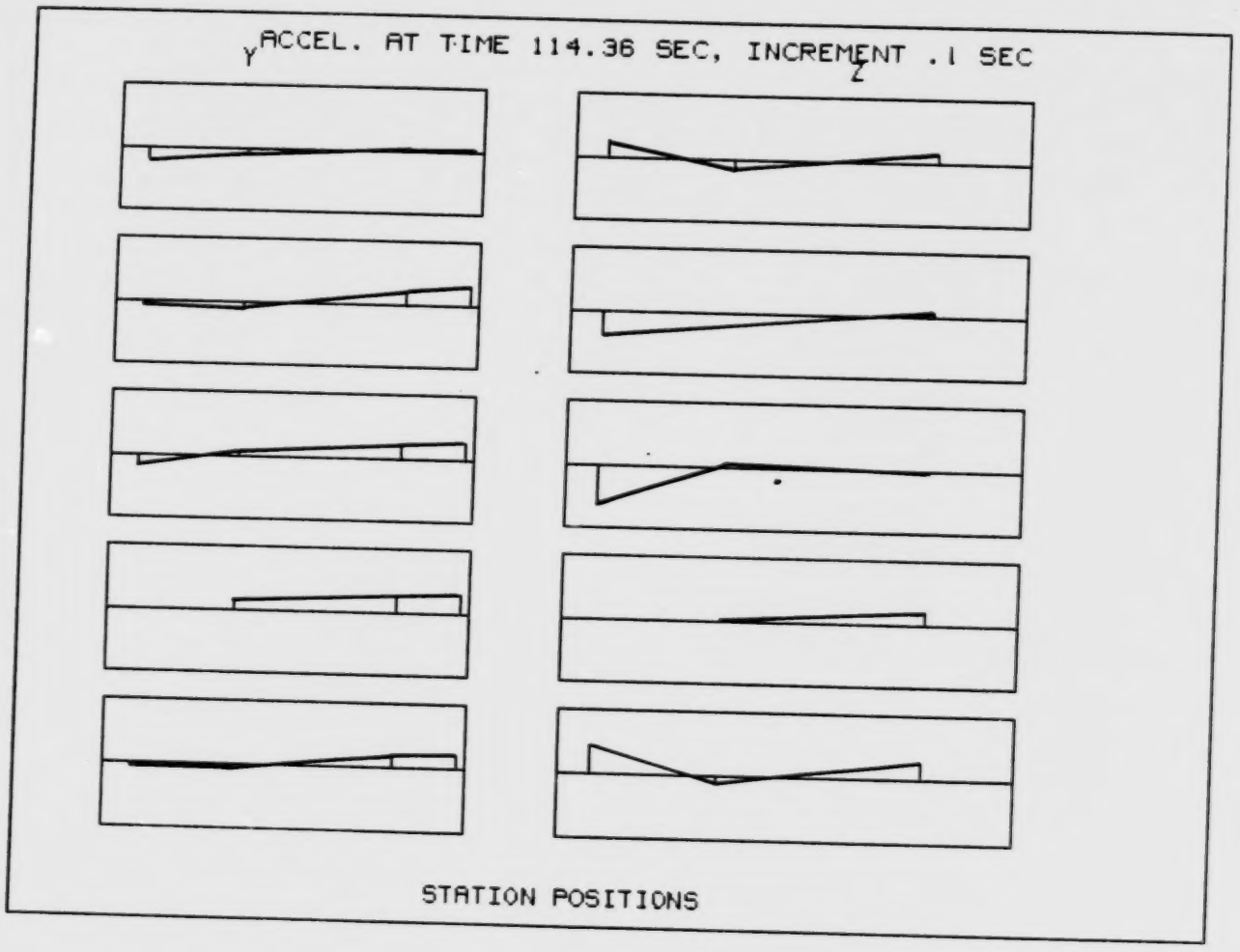
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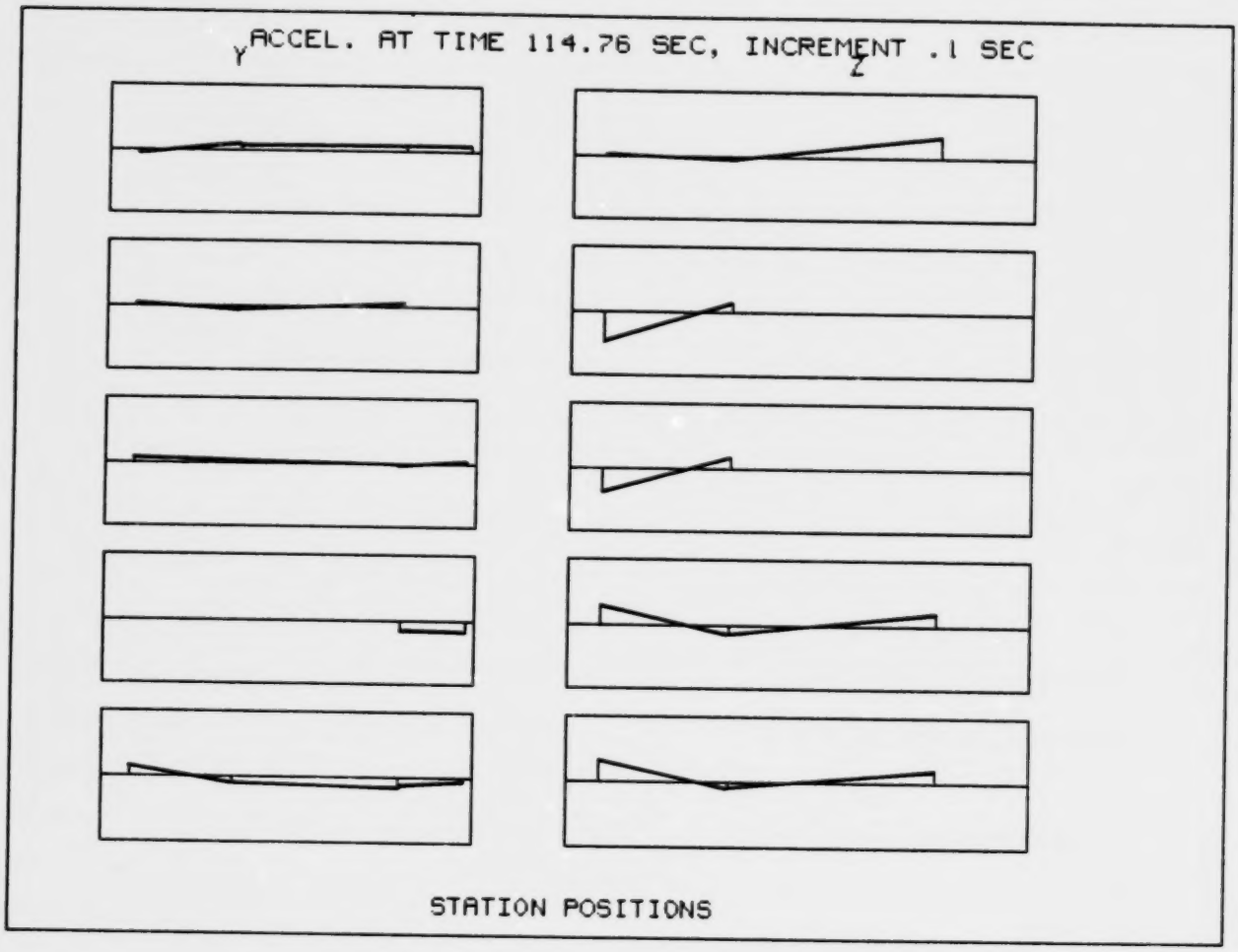
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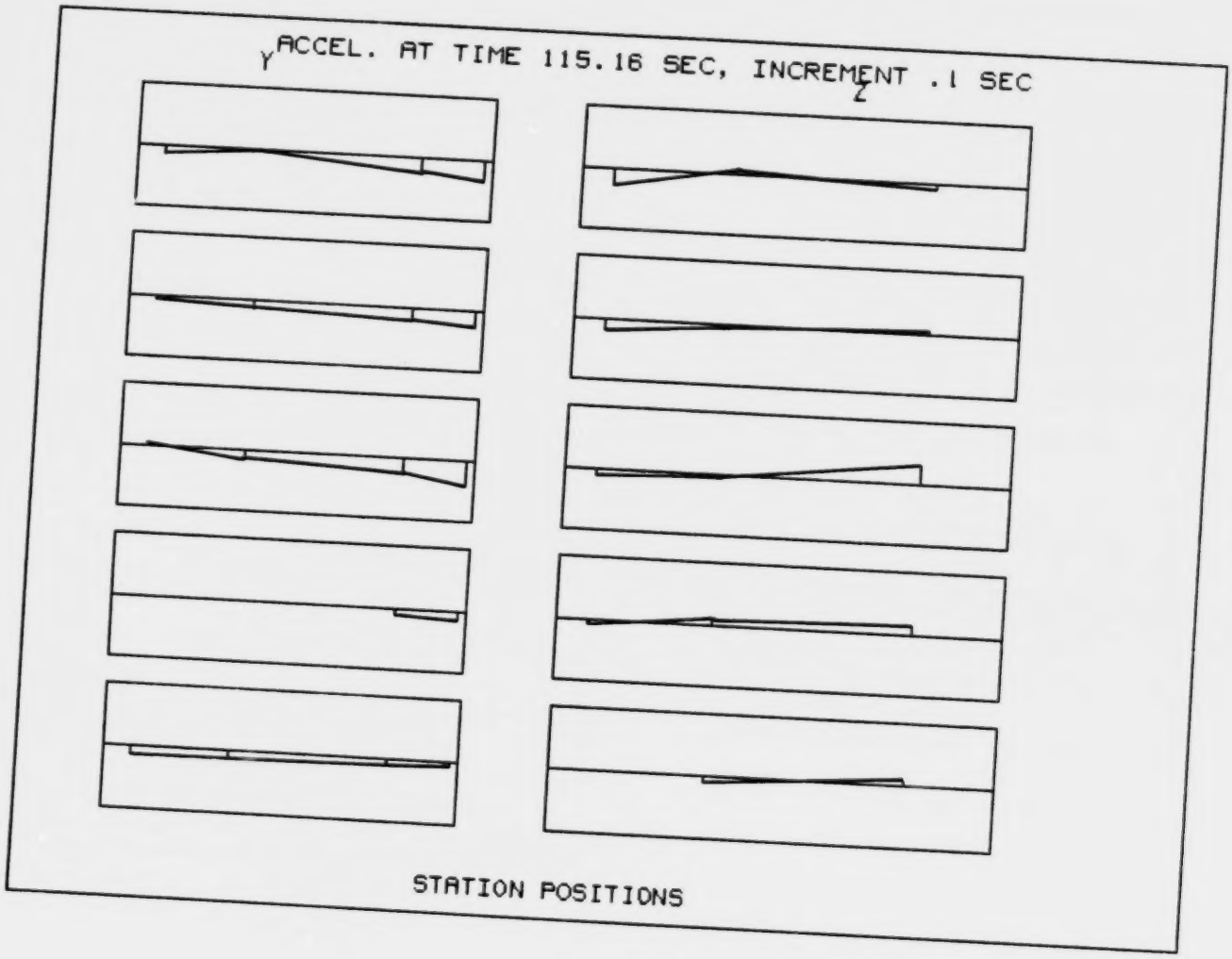
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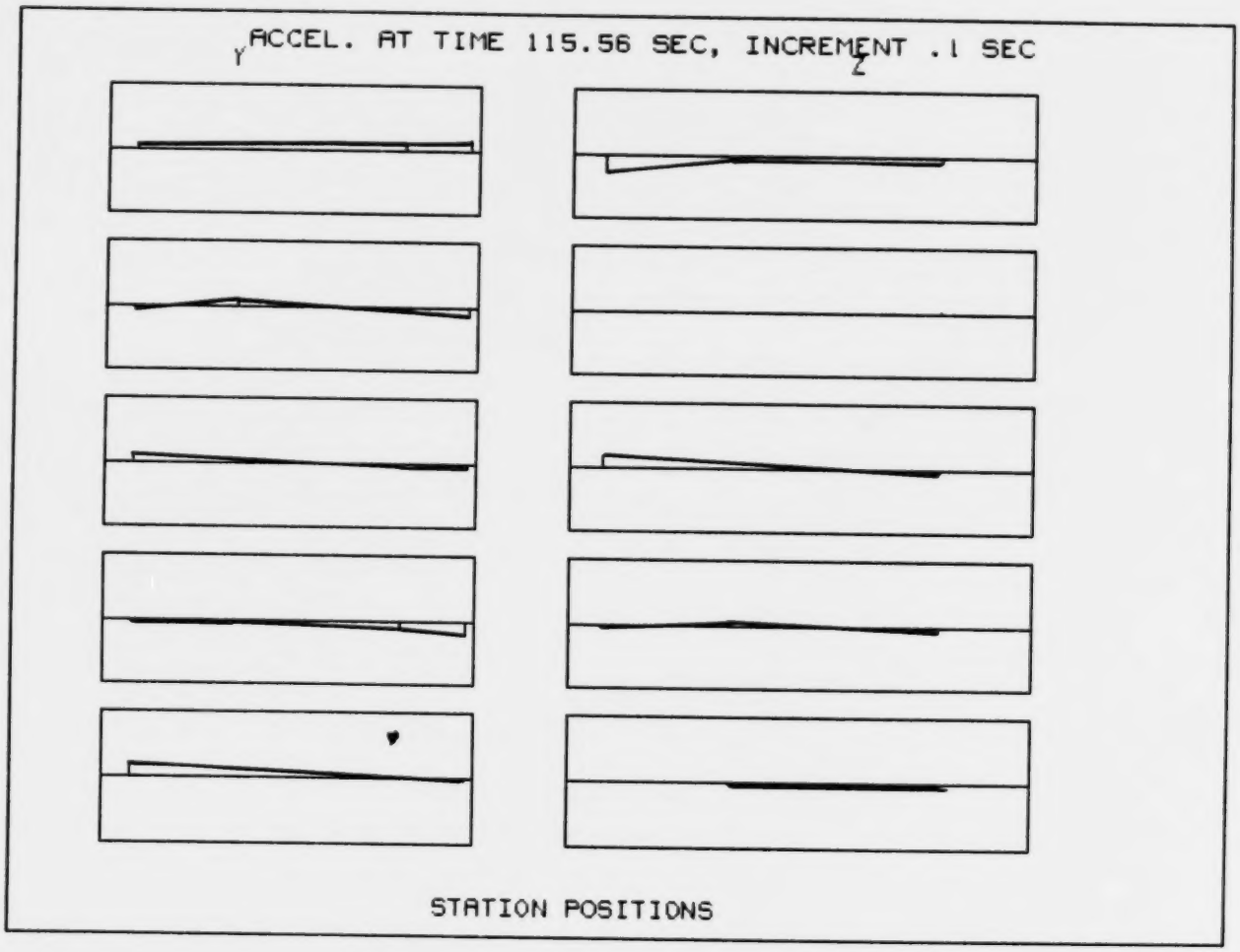
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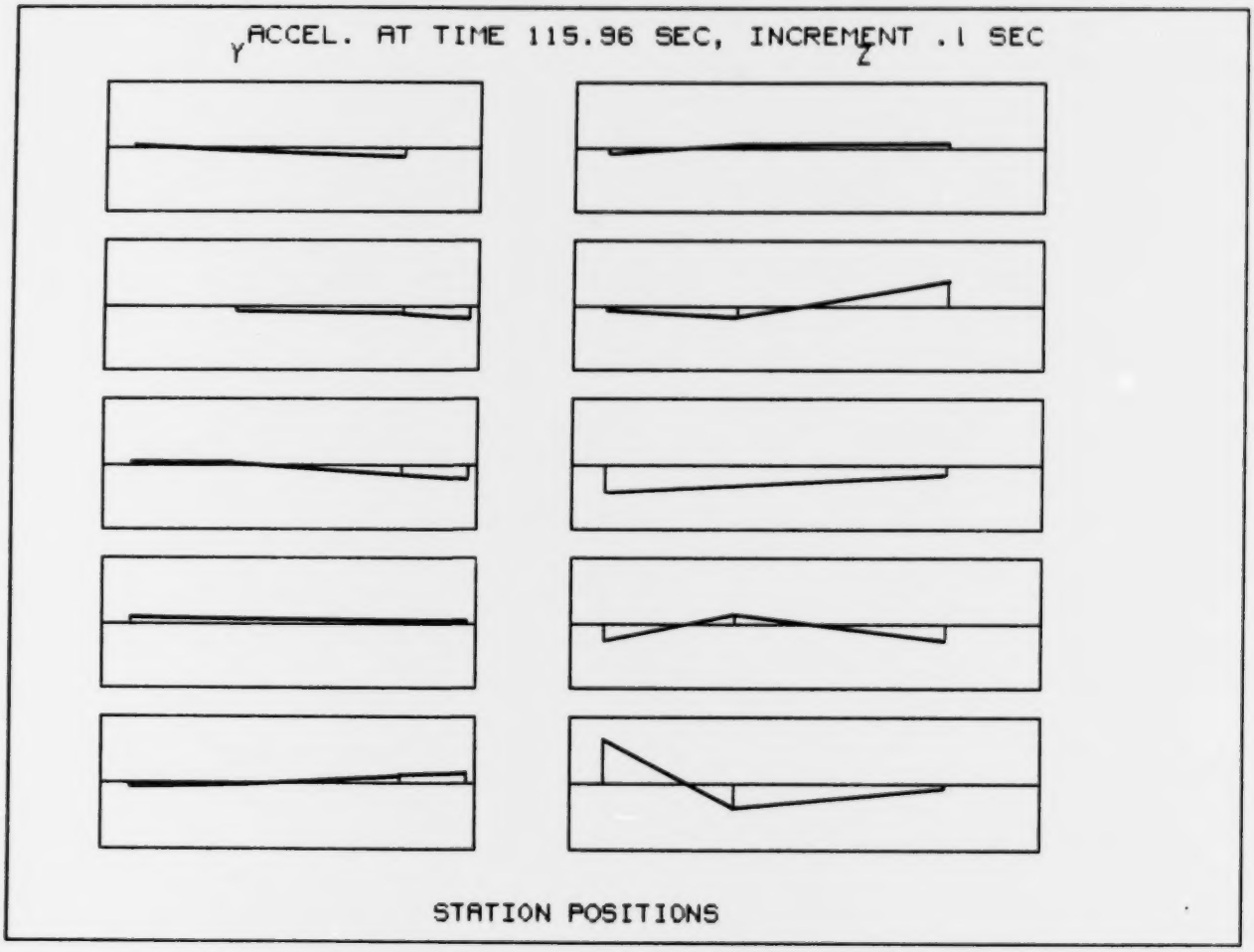
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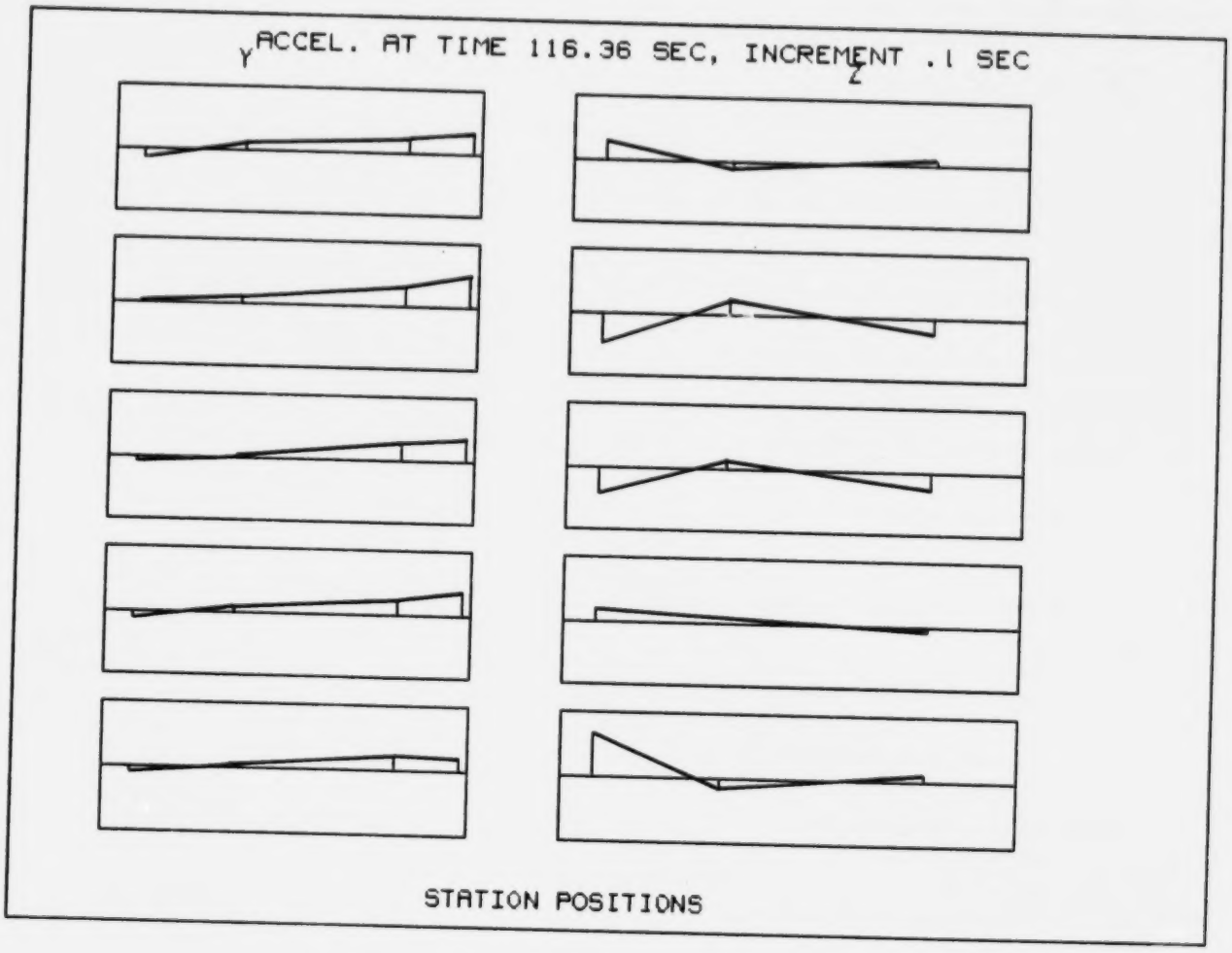
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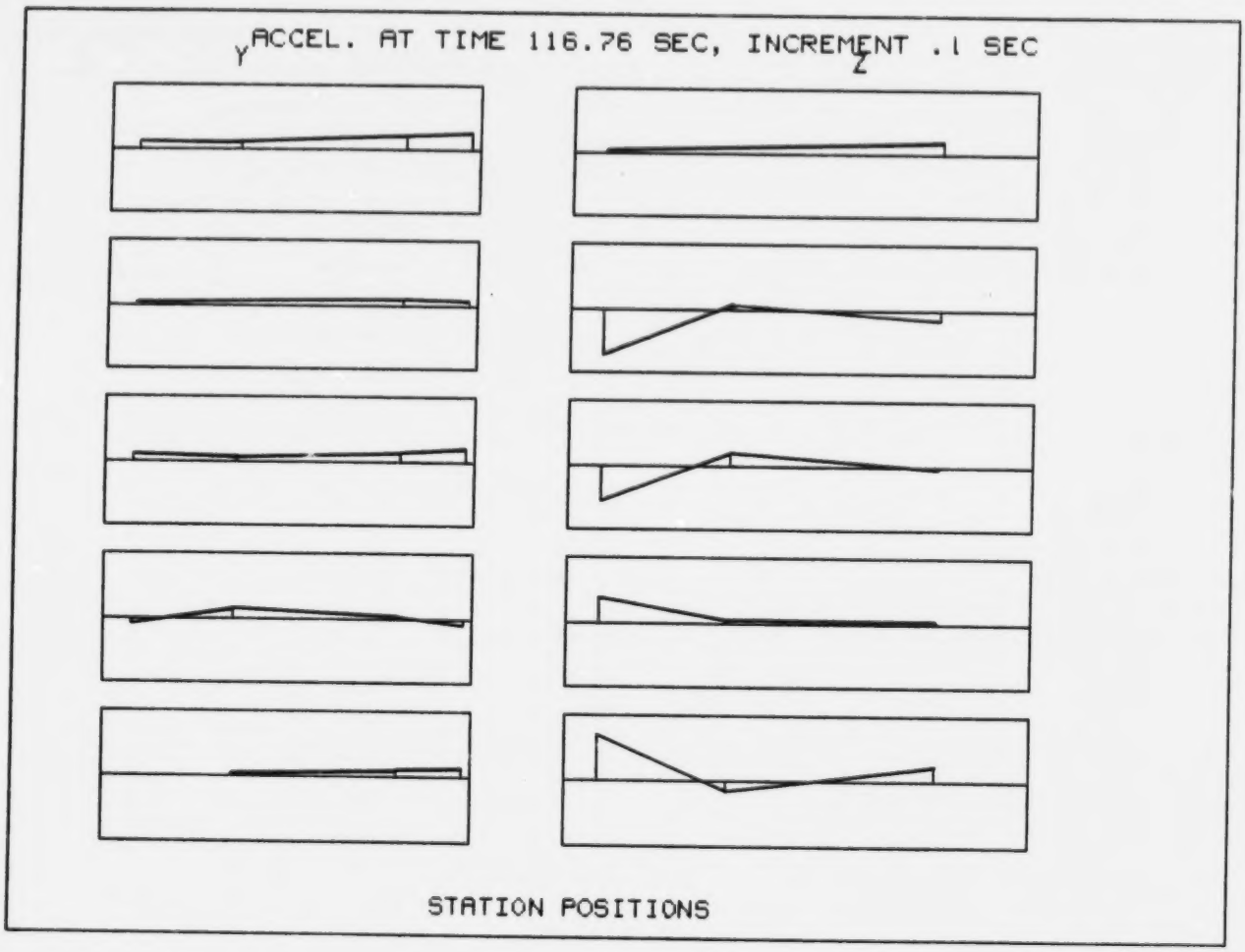
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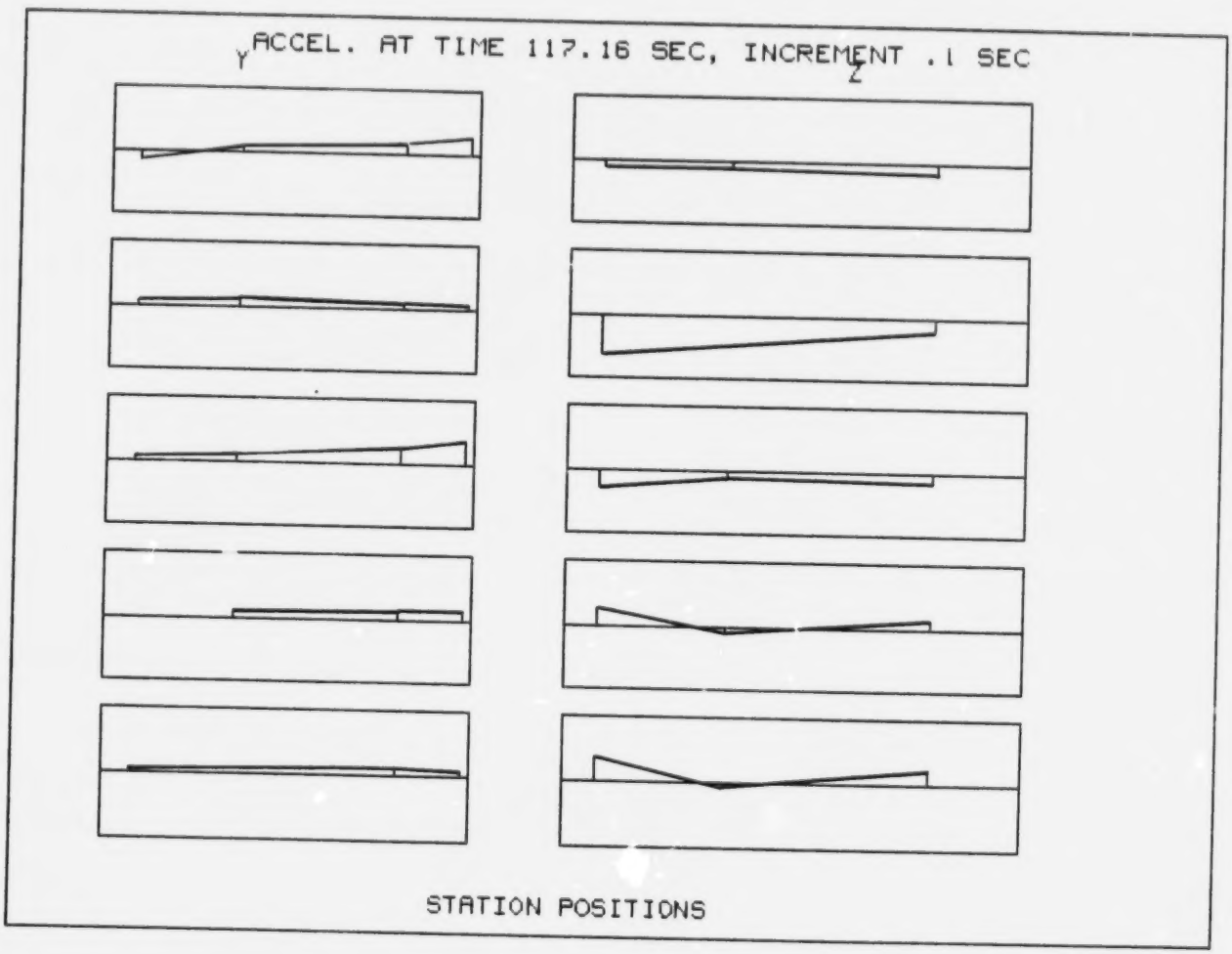
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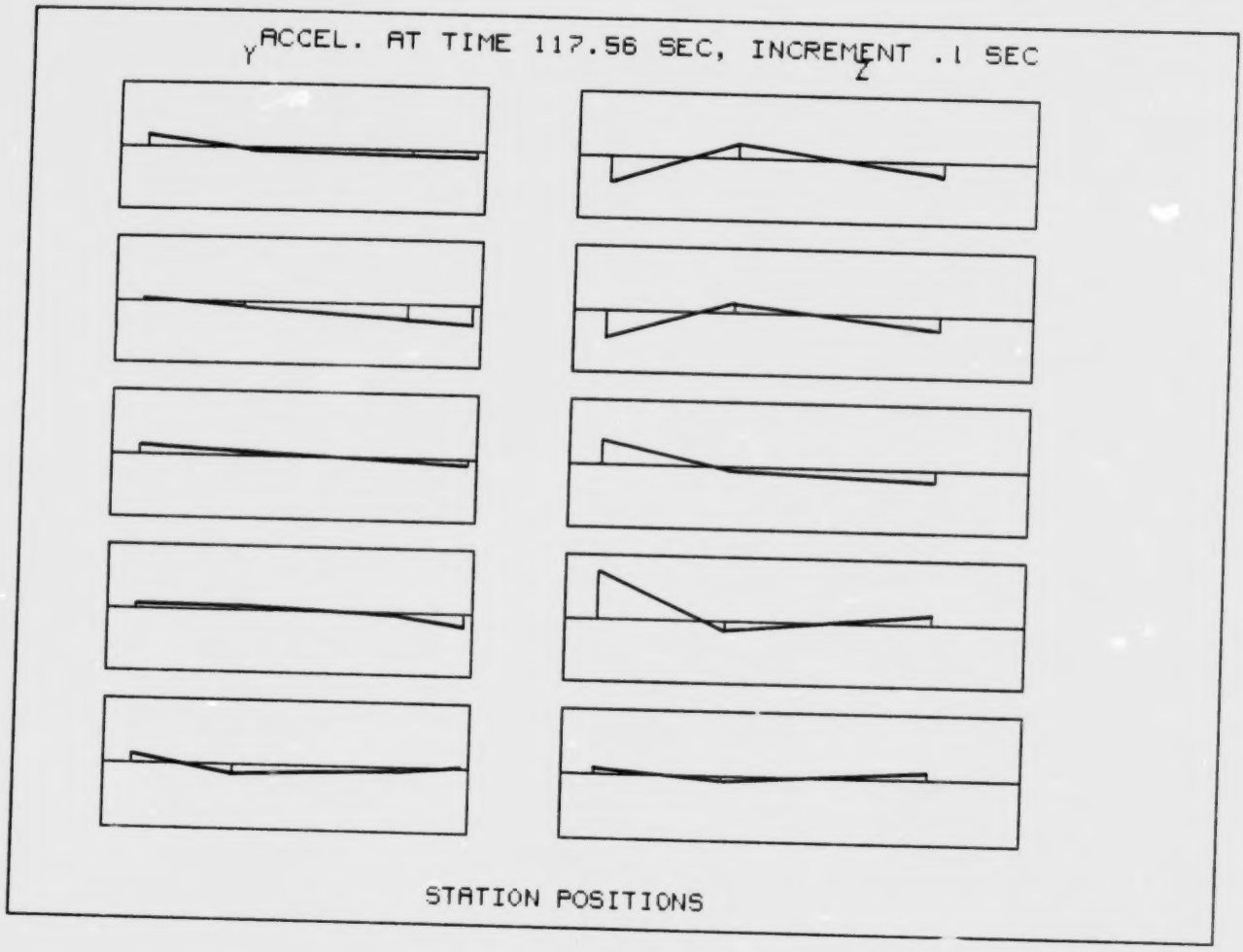
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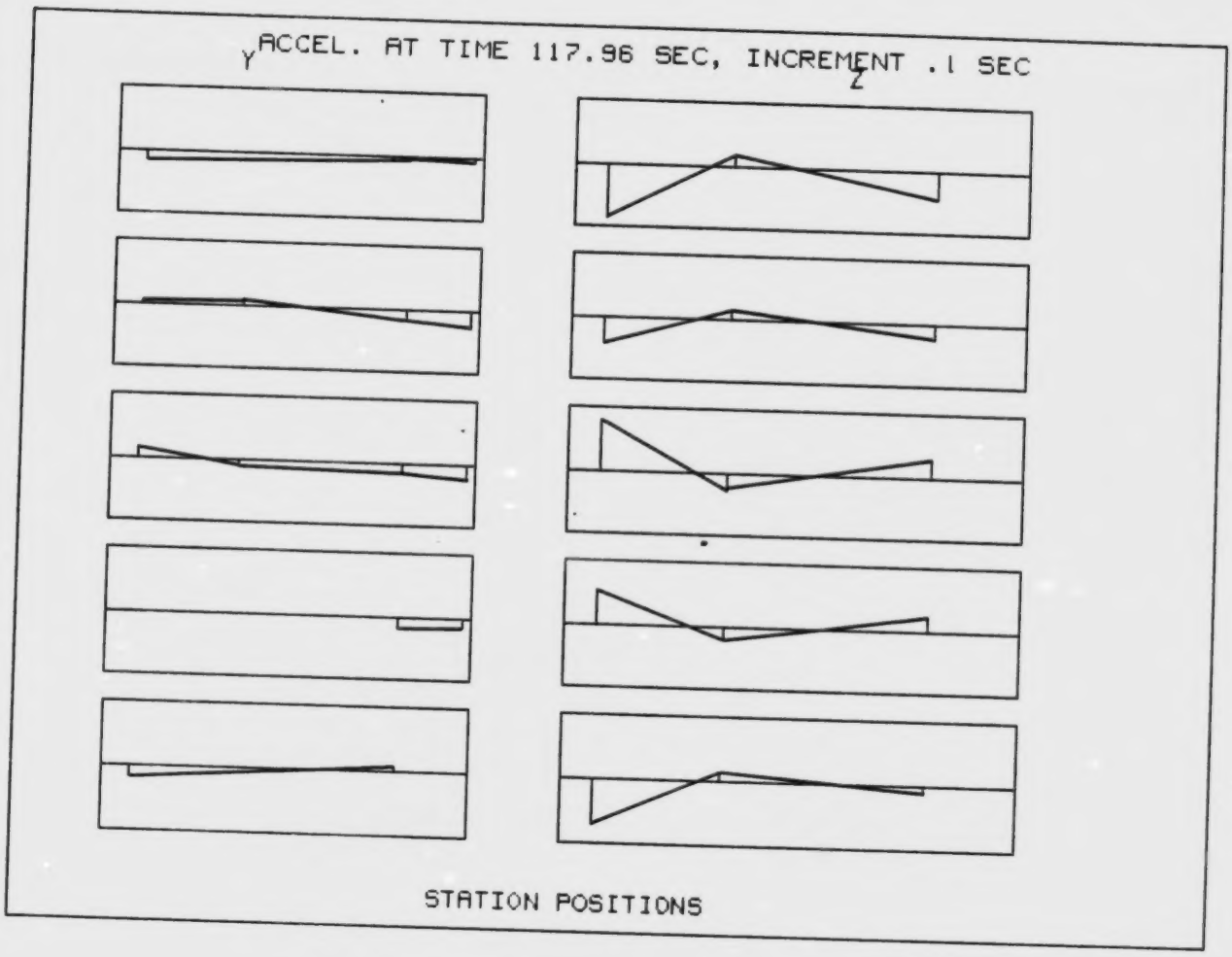
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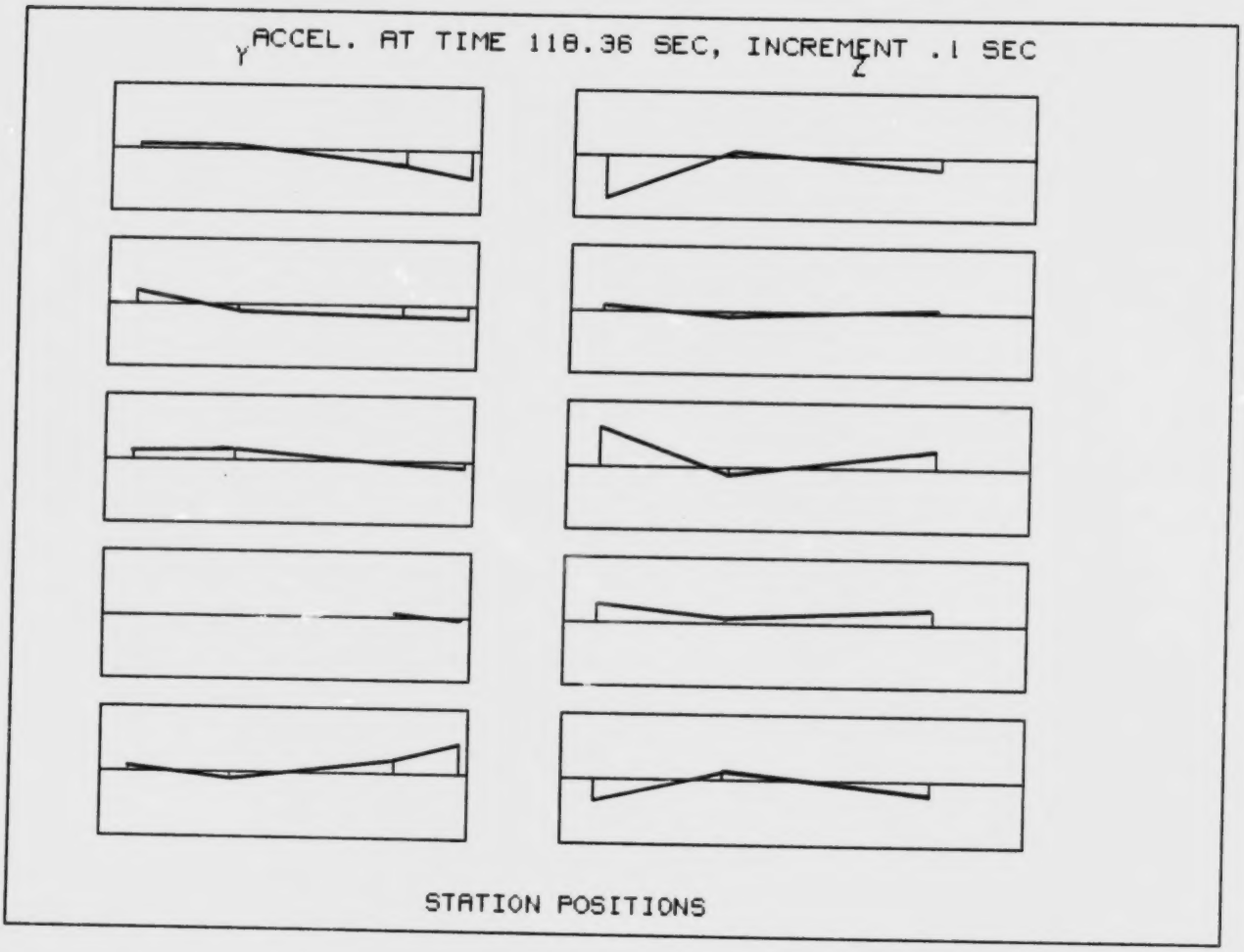
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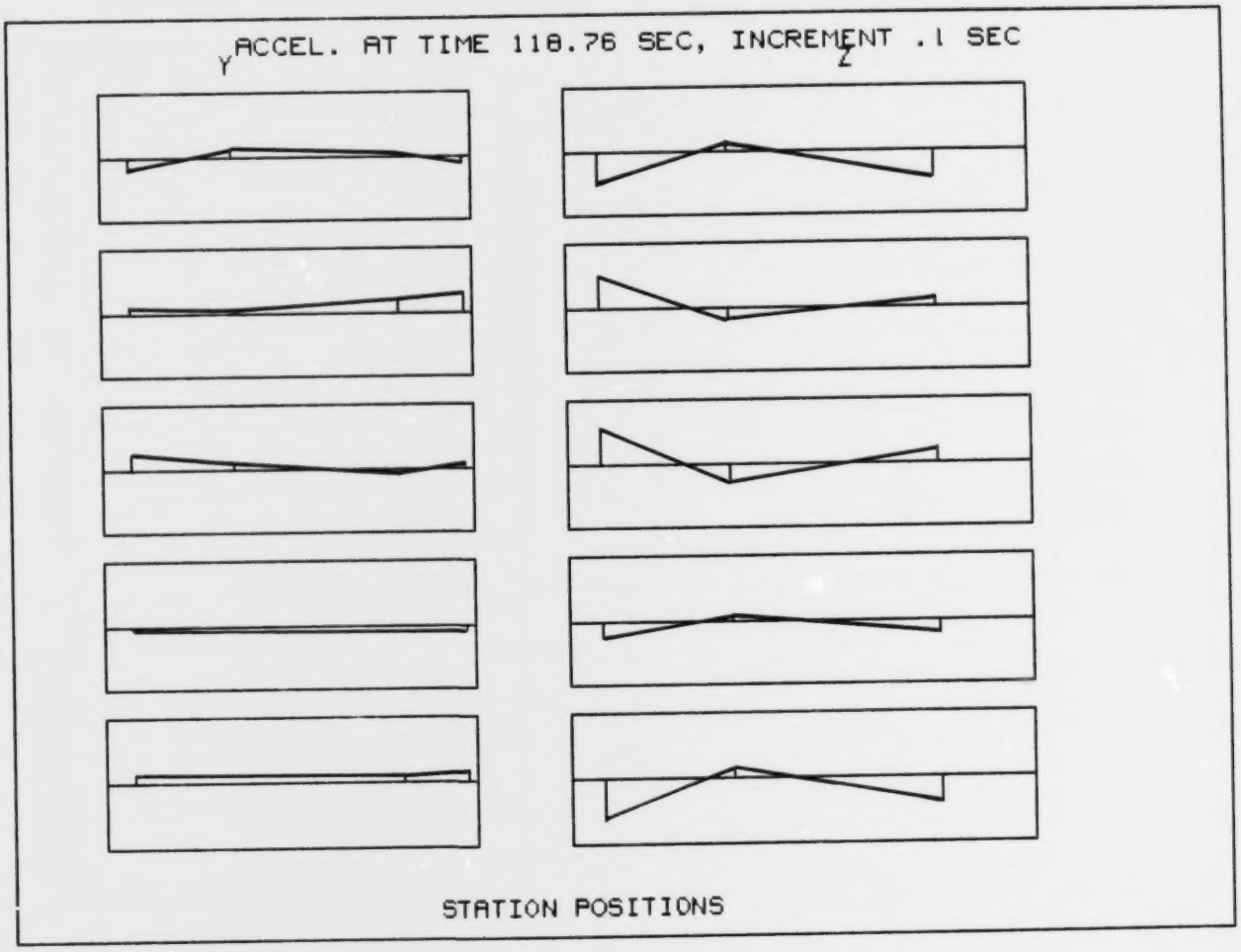
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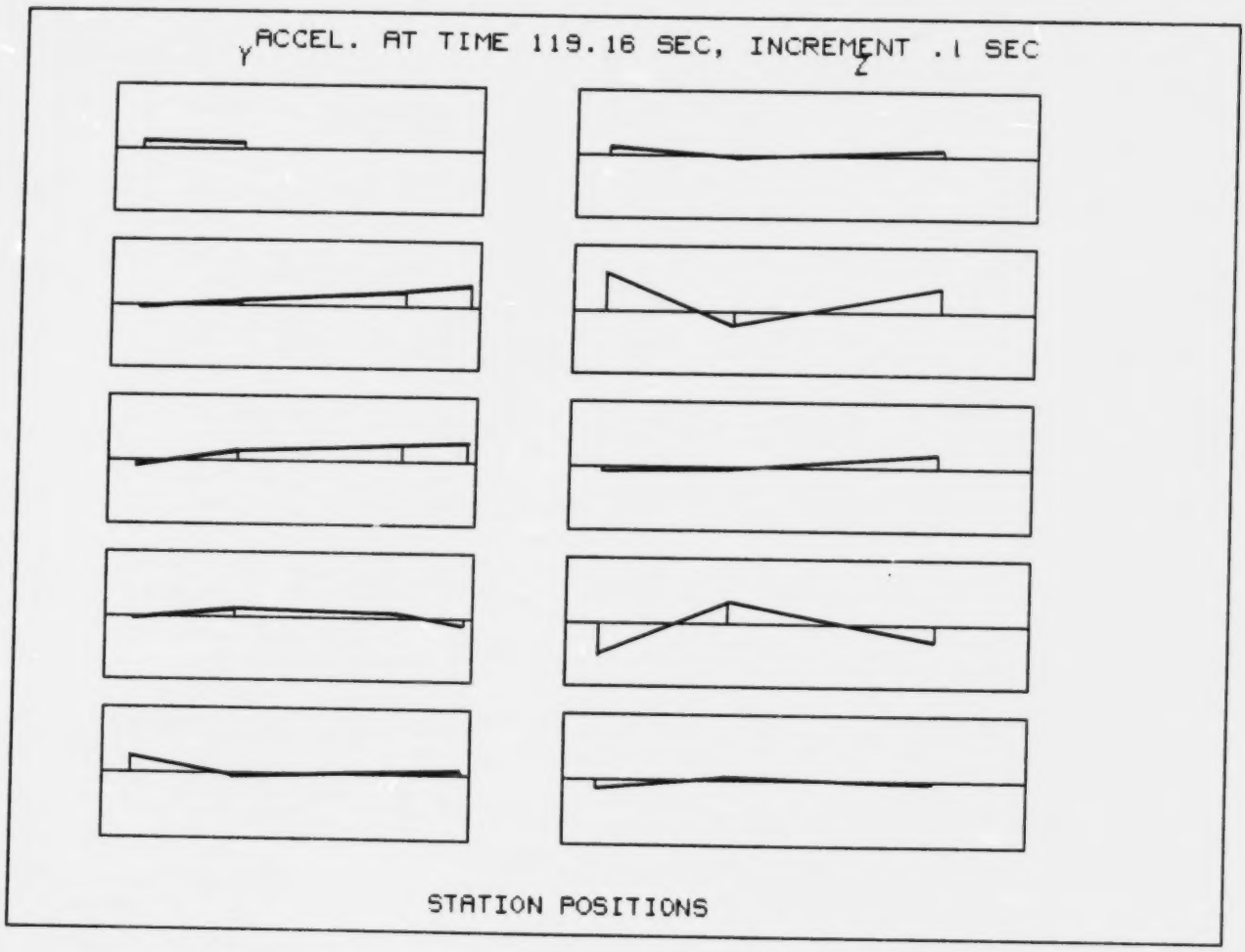
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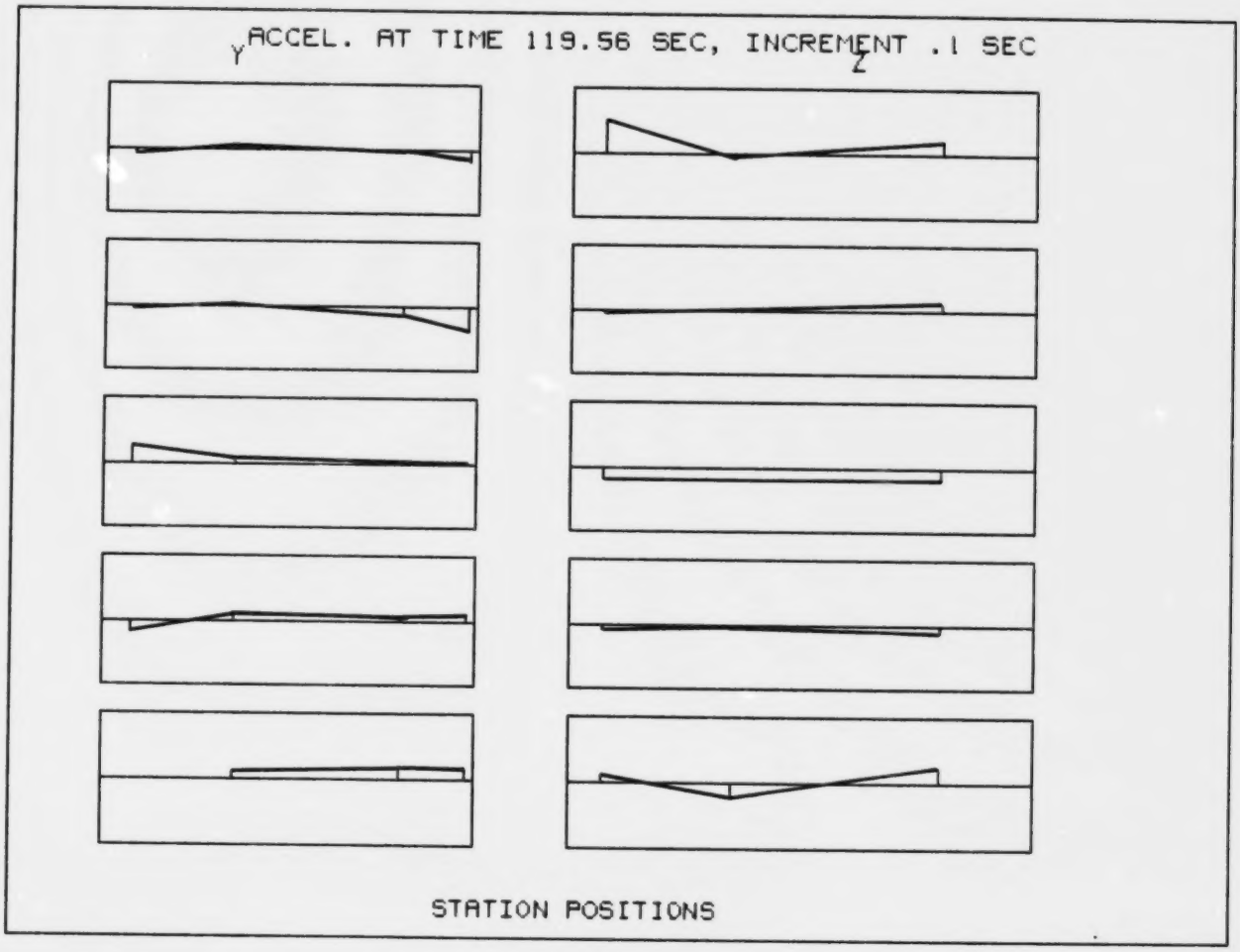
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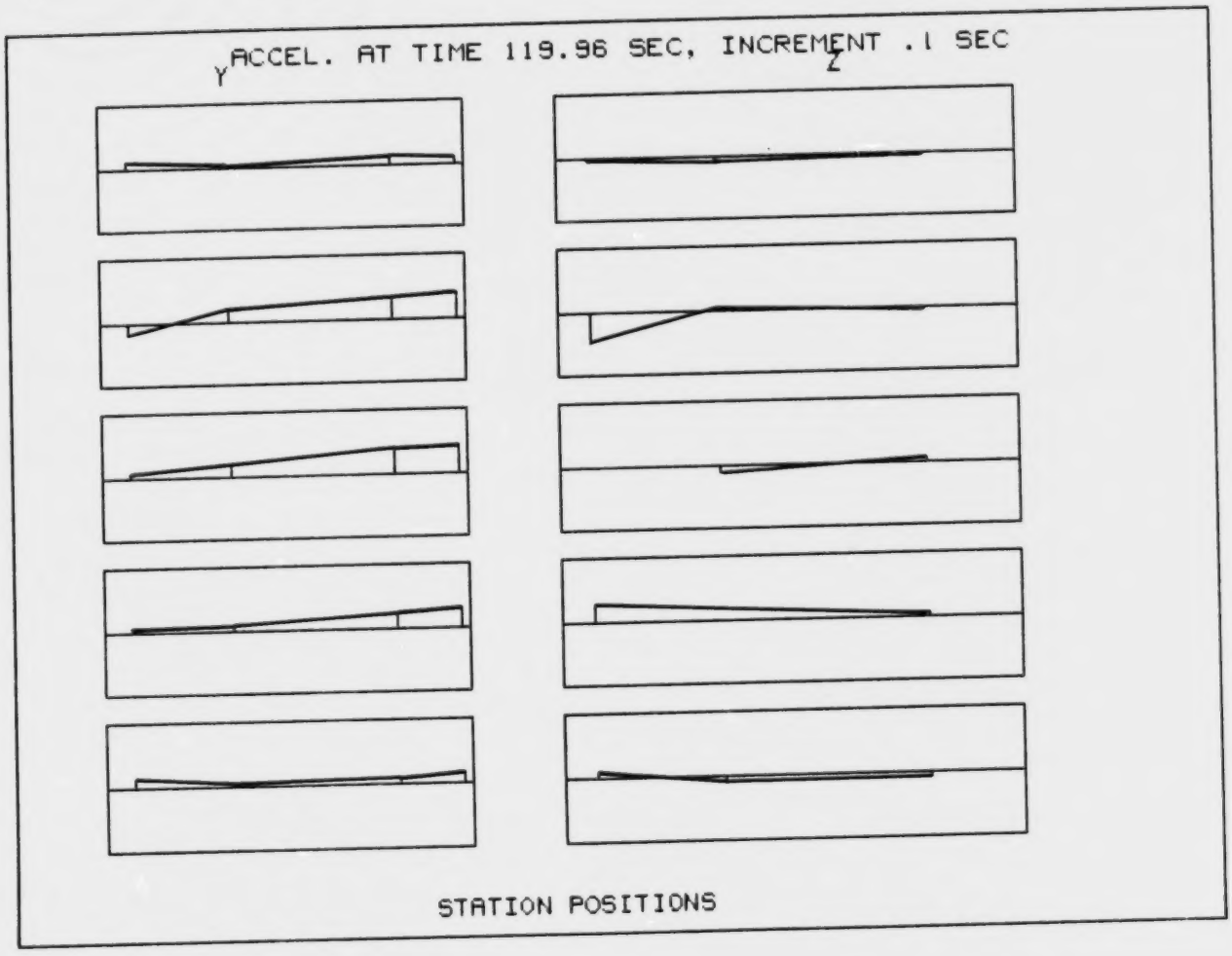
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Z
STATION POSITIONS

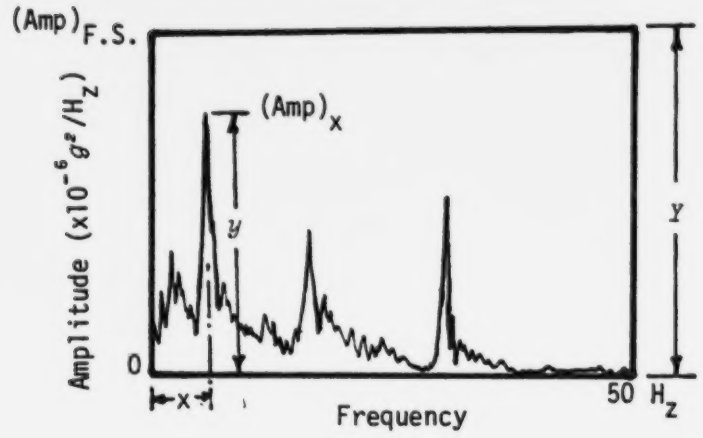
ANNEX 6

ACCELERATION SPECTRA

TABLE

SCENARIO	DAY-TIME GROUP	FIGURES FOR 50 Hz	FIGURES FOR 500 Hz
OPEN WATER TURNING	01:29:10:57		6.1 a - h
CRASH REVERSAL	01:29:13:58		6.2 a - h
BACKING IN LEVEL ICE	01:31:13:02	6.3 a - h	6.4 a - h
CONTINUOUS ICE TRANSIT (9.3 kts, 1.5' thk)	01:30:23:43	6.5 a - h	6.6 a - h
CONTINUOUS ICE TRANSIT (6 kts., 1.5' thk)	01:31:14:10	6.7 a - h	6.8 a - h
RAMMING LEVEL ICE (Oblique, 9 kts, 4' thk)	02:08:02:30	6.9 a - h	
RAMMING LEVEL ICE (Oblique, 9 kts, 4' thk)	02:09:06:20	6.10 a - h	
RAMMING LEVEL ICE (Head-on, 5.33 kts, 4' thk)	02:09:06:09	6.11 a - h	
RAMMING LEVEL ICE (Head-on, 4 kts, 3' thk)	02:09:14:00	6.12 a - h	
RAMMING PRESSURE RIDGE (Oblique, 6 kts., 4' thk)	02:08:02:23	6.14 a - h	6.13 a - h
OBLIQUE IMPACT (9 kts., 2' thk)	02:08:23:50	6.15 a - h	
OBLIQUE IMPACT (7 kts., 4' thk)	02:09:06:26	6.16 a - h	6.17 a - h
OPEN WATER PRIOR TO TEST	02:08:02:23	6.18 a - h	
OPEN WATER PRIOR TO TEST	02:08:23:50	6.19 a - h	

PROCEDURE FOR COMPUTING FREQUENCY AMPLITUDE



Consider the above sketch representing an acceleration power spectrum; the amplitude of acceleration spectral density at any frequency can be determined by:

$$(\text{Amp})_x = \left(\frac{y}{Y}\right)^2 (\text{Amp})_{\text{F.S.}}$$

where y = vertical measurement in inch or mm at frequency x

Y = vertical scale in inch or mm

$(\text{Amp})_{\text{F.S.}}$ = full-scale calibrated amplitude

The readers are reminded that this procedure is only applicable for Figures 6.1 to 6.17.

FIGURE 6.1a PEAK AVERAGE ACCELERATION SPECTRUM

Event :OPEN WATER TURNING
Vessel : USCGC POLAR SEA
Sensor : 'BOW SWAY'
Frequency: 500 (Hz)

Test Time : 81:01:29:10:57
Calibration: 1.1940 (g'/v)

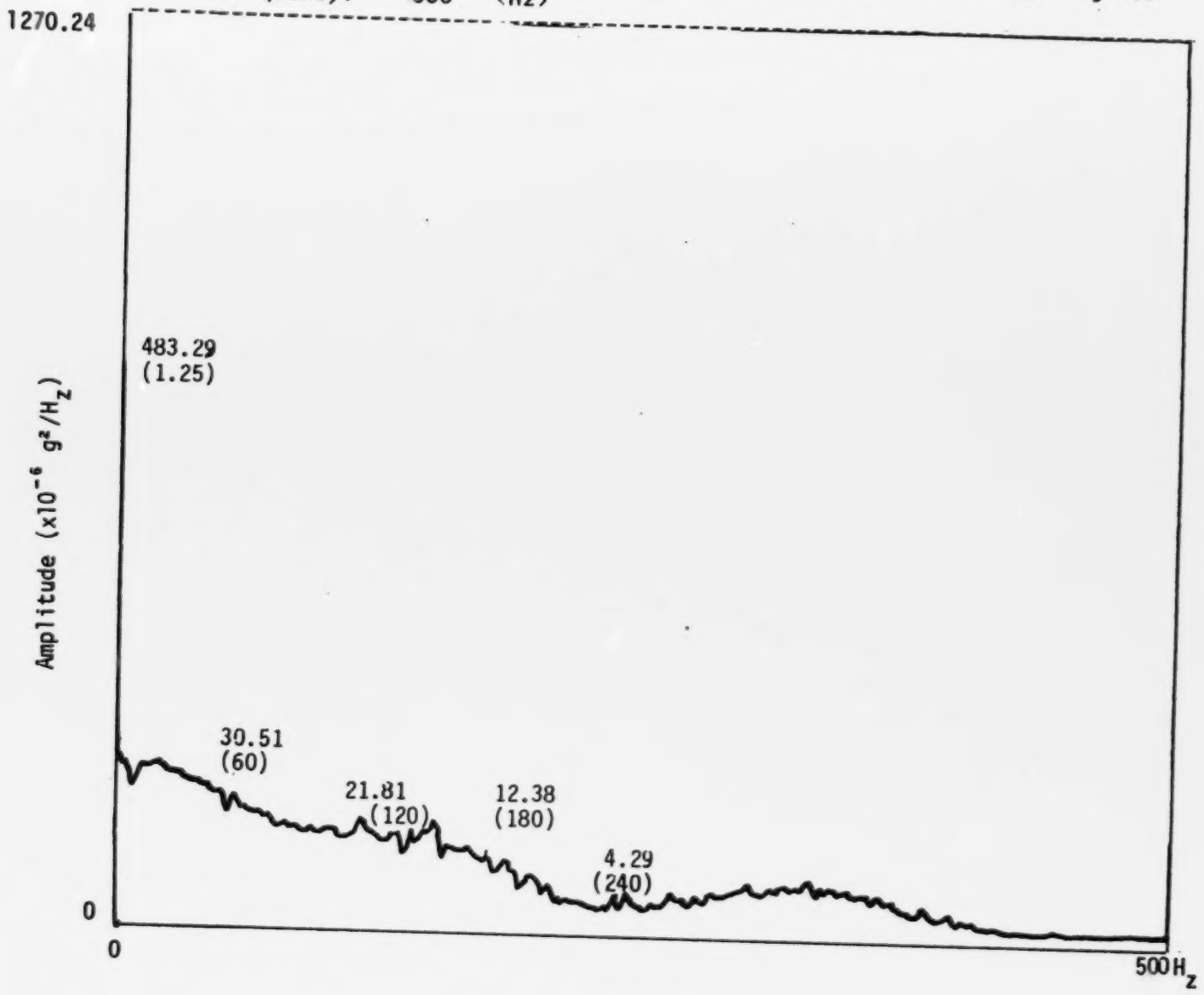


FIGURE 6.1b PEAK AVERAGE ACCELERATION SPECTRUM

Event :OPEN WATER TURNING
Vessel : USCGC POLAR SEA
Sensor : 'BOW HEAVE'
Frequency: 500 (Hz)

Test Time : 81:01:29:10:57
Calibration: 1.2500 (g'/v)

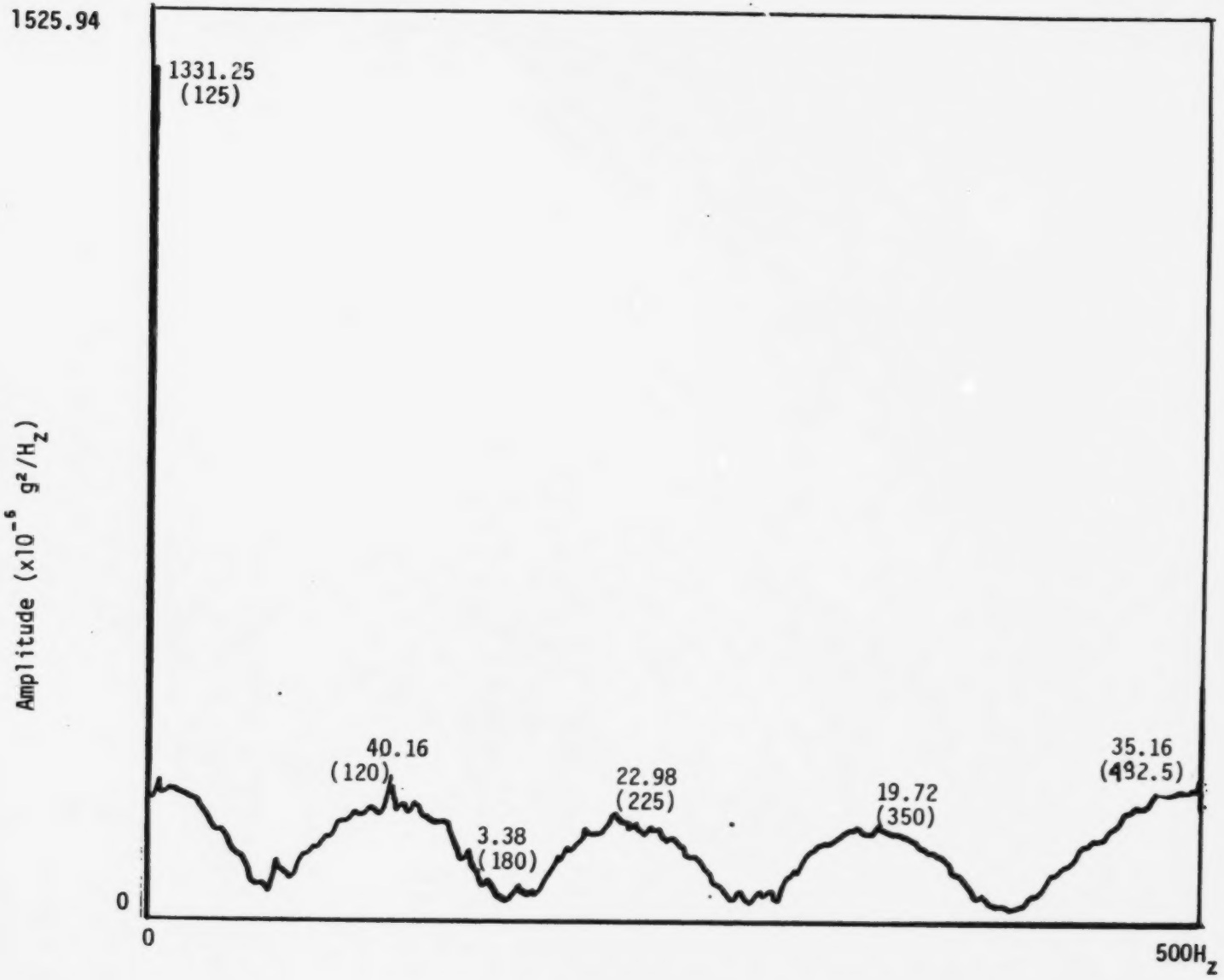


FIGURE 6.1c PEAK AVERAGE ACCELERATION SPECTRUM

Event :OPEN WATER TURNING
Vessel : USCGC POLAR SEA
Sensor : 'SURGE'
Frequency: 500 (Hz)

Test Time : 81:01:29:10:57
Calibration: .9591 (g'/v)

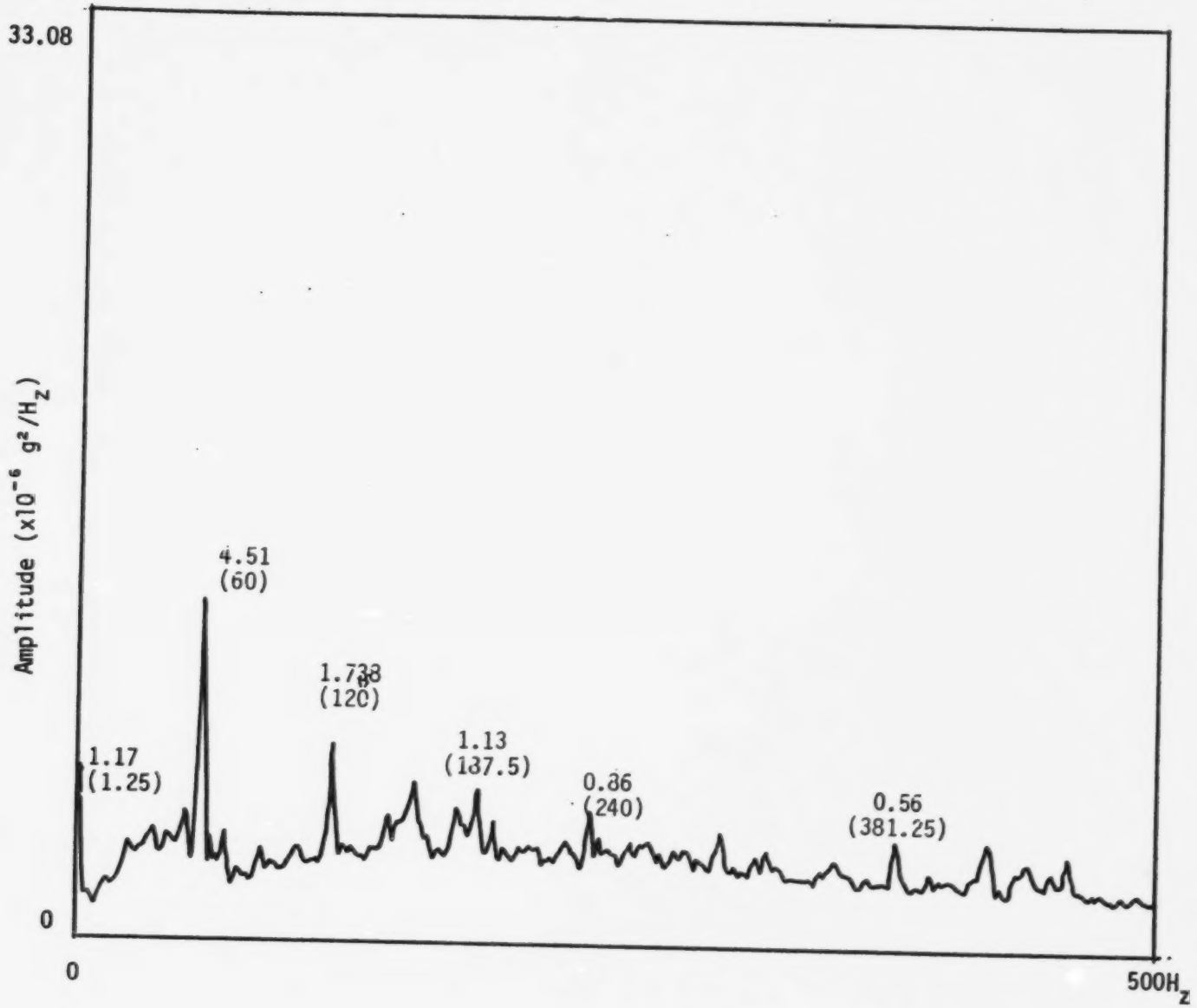


FIGURE 6.1d PEAK AVERAGE ACCELERATION SPECTRUM

Event :OPEN WATER TURNING
Vessel : USCGC POLAR SEA
Sensor : 'SWAY'
Frequency: 500 (Hz)

Test Time : 81:01:29:10:57
Calibration: .9547 (g'/v)

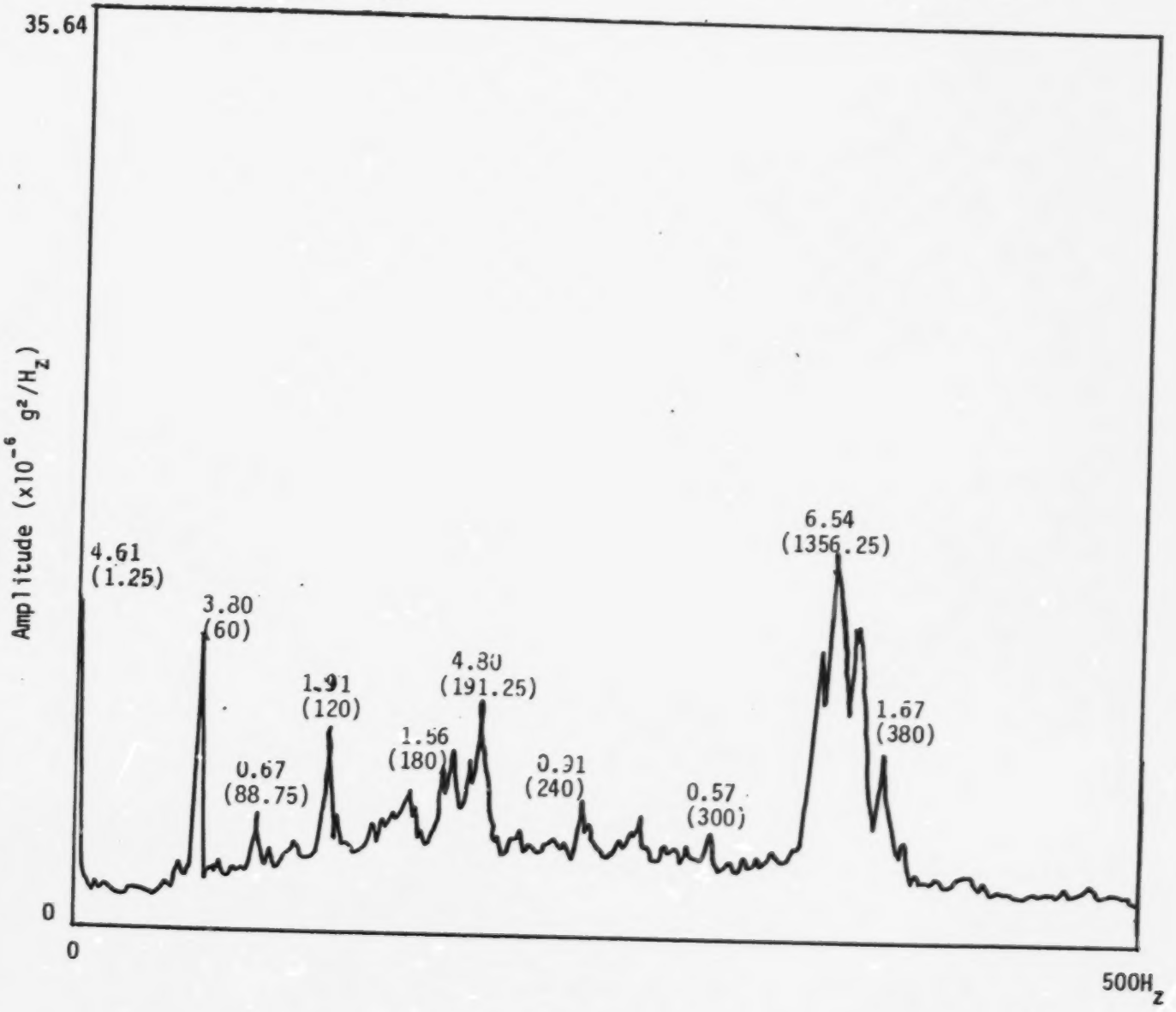


FIGURE 6.1e PEAK AVERAGE ACCELERATION SPECTRUM

Event :OPEN WATER TURNING
Vessel : USCGC POLAR SEA
Sensor : 'HEAVE'
Frequency: 500 (Hz)

Test Time : 81:01:29:19:57
Calibration: .9603 (g'/v)

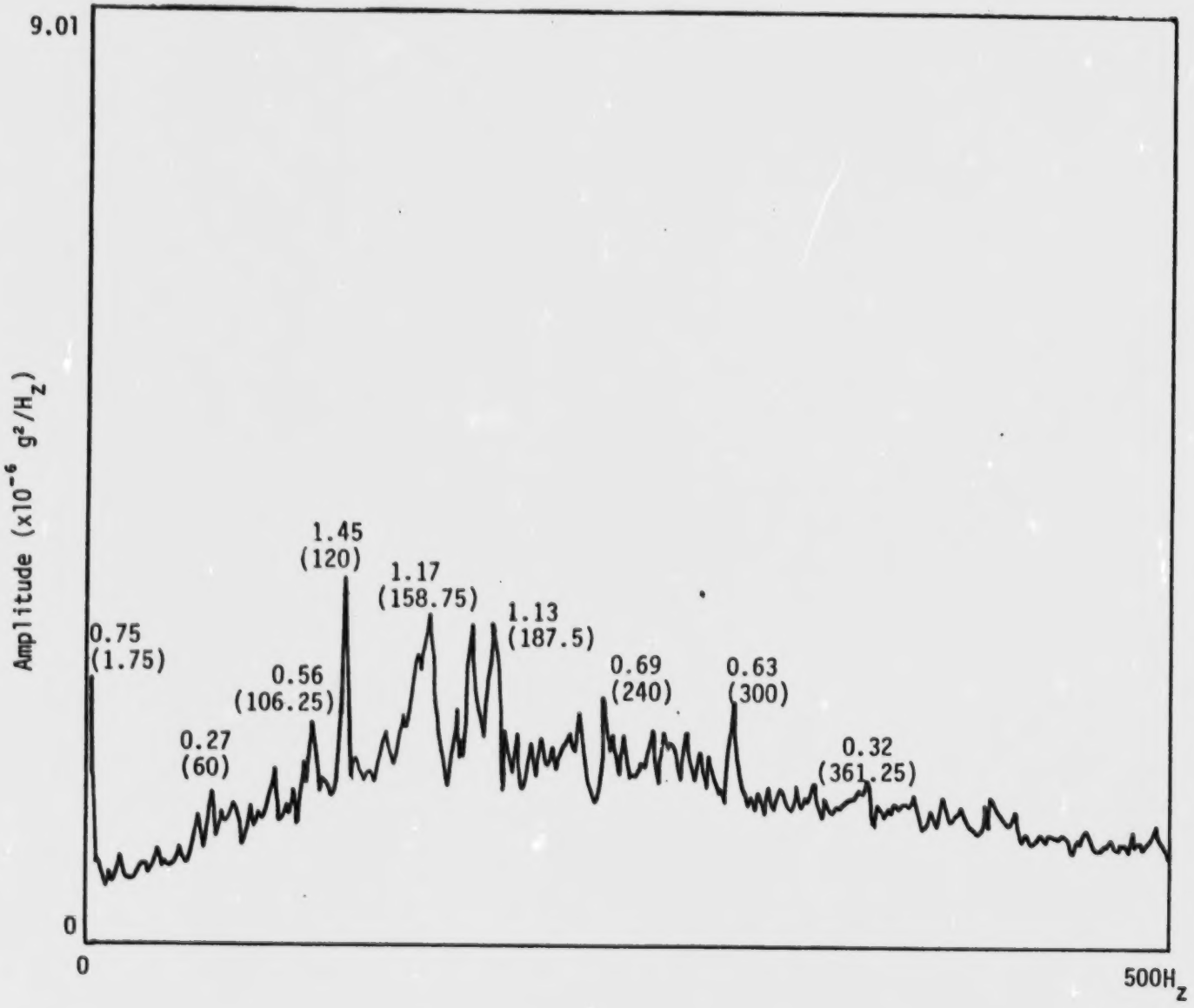


FIGURE 6.1f PEAK AVERAGE ACCELERATION SPECTRUM

Event :OPEN WATER TURNING
Vessel : USCGC POLAR SEA
Sensor : 'AFT SURGE'
Frequency: 500 (Hz)

Test Time : 81:01:29:10:57
Calibration: 1.1834 (g'/v)

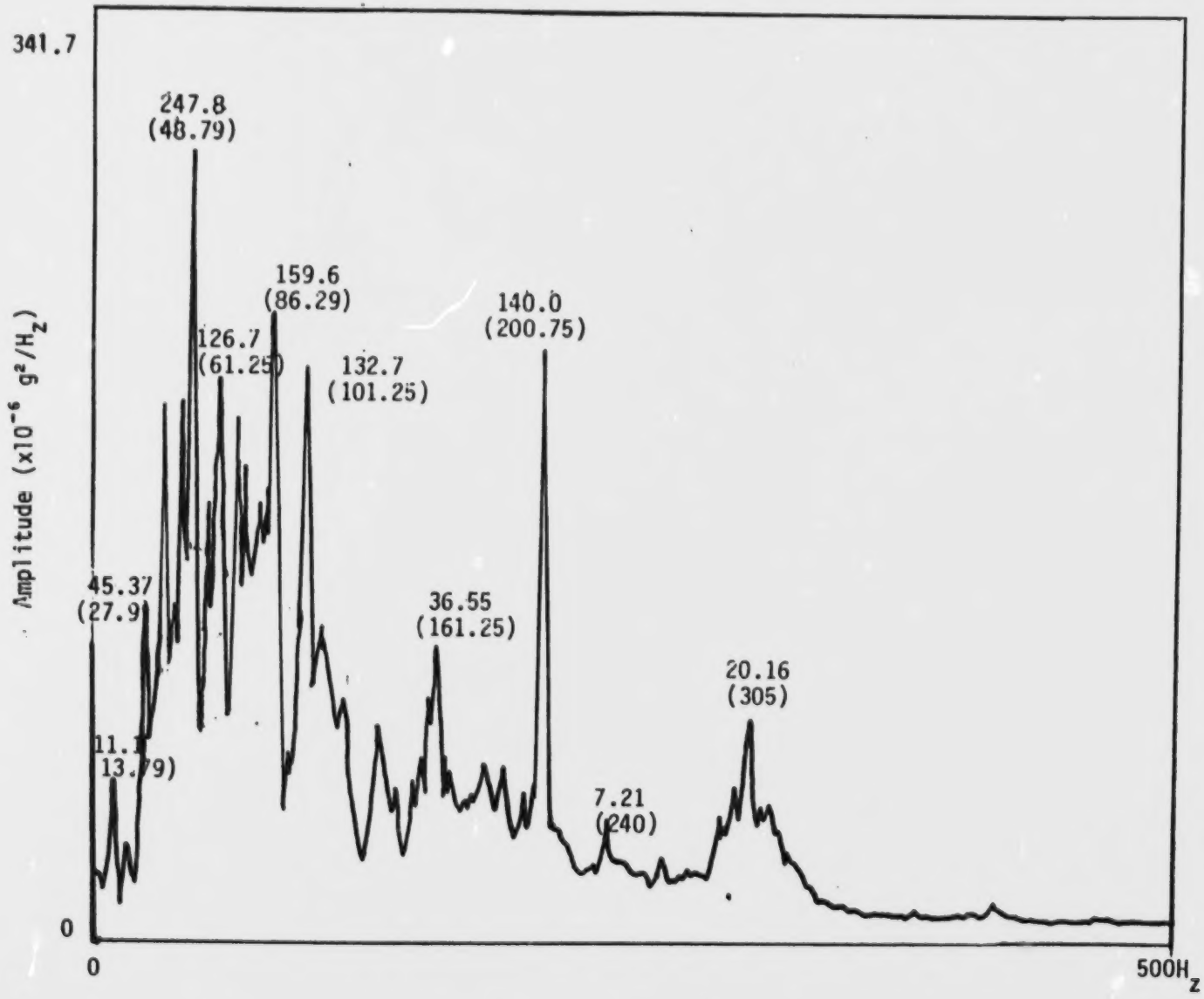


FIGURE 6.1g PEAK AVERAGE ACCELERATION SPECTRUM

Event :OPEN WATER TURNING
Vessel : USCGC POLAR SEA
Sensor : 'AFT SWAY'
Frequency: 500 (Hz)

Test Time : 81:01:29:10:57
Calibration: 1.2270 (g'/v)

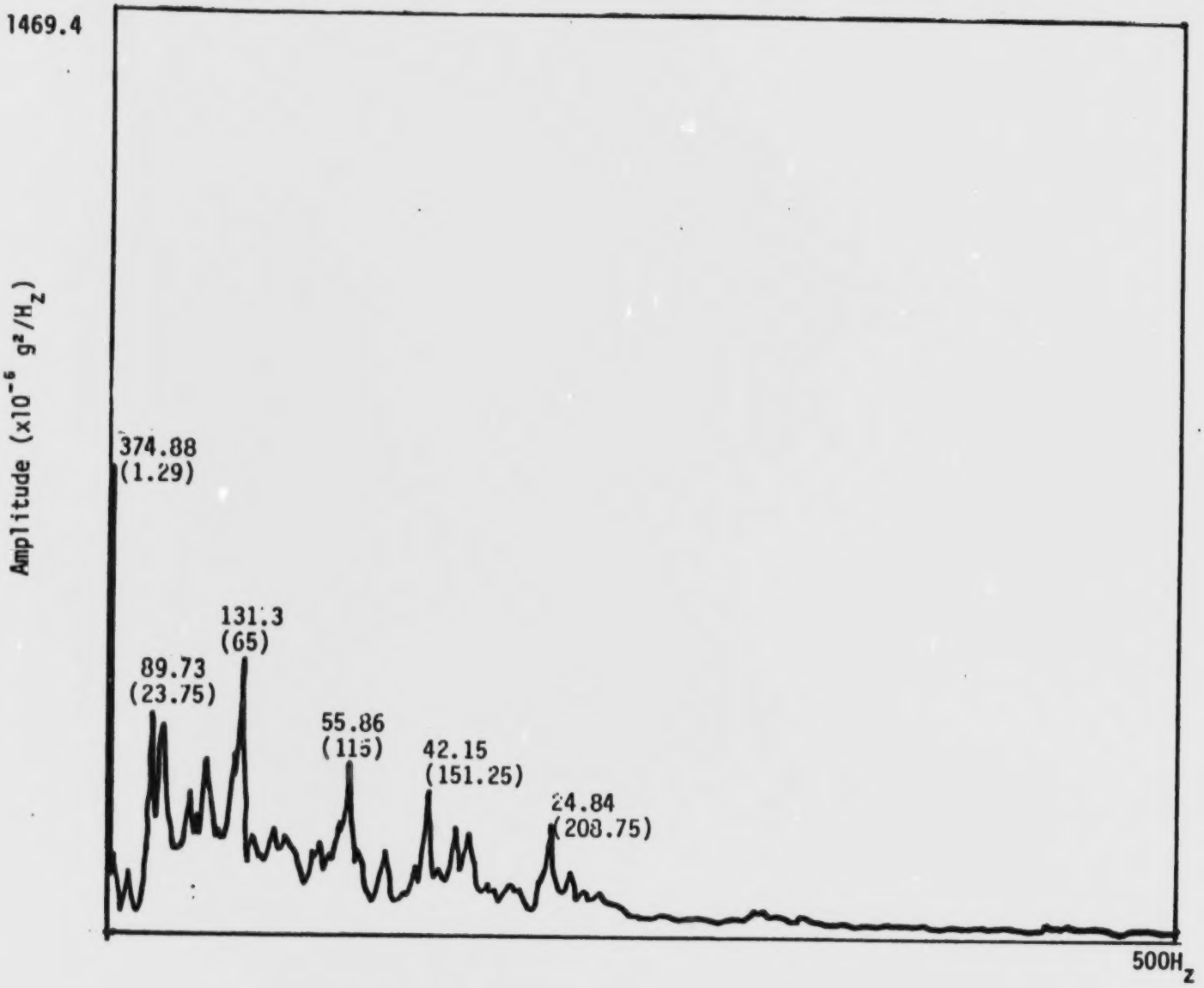


FIGURE 6.1h PEAK AVERAGE ACCELERATION SPECTRUM

Event :OPEN WATER TURNING
Vessel : USCGC. POLAR SEA
Sensor : 'AFT HEAVE'
Frequency: 500 (Hz)

Test Time : 81:01:29:10:57
Calibration: 1.2345 (g'/v)

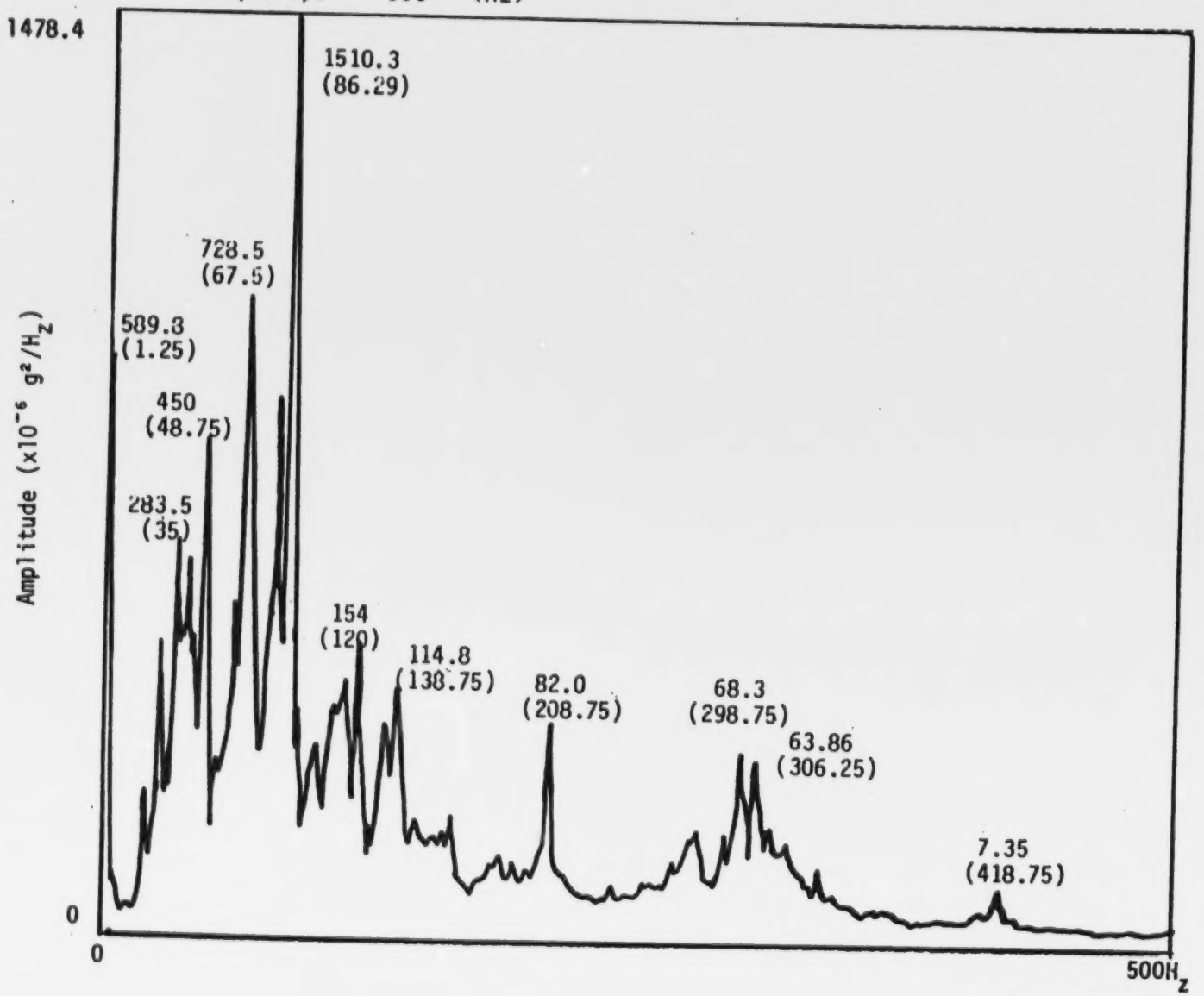


FIGURE 6.2a PEAK AVERAGE ACCELERATION SPECTRUM

Event :CRASH REVERSAL IN OPEN WATER
Vessel : USCGC POLAR SEA
Sensor : 'BOW SWAY'
Frequency: 500 (Hz)

Test Time : 81:01:29:13:58
Calibration: 1.1940 (g'/v)

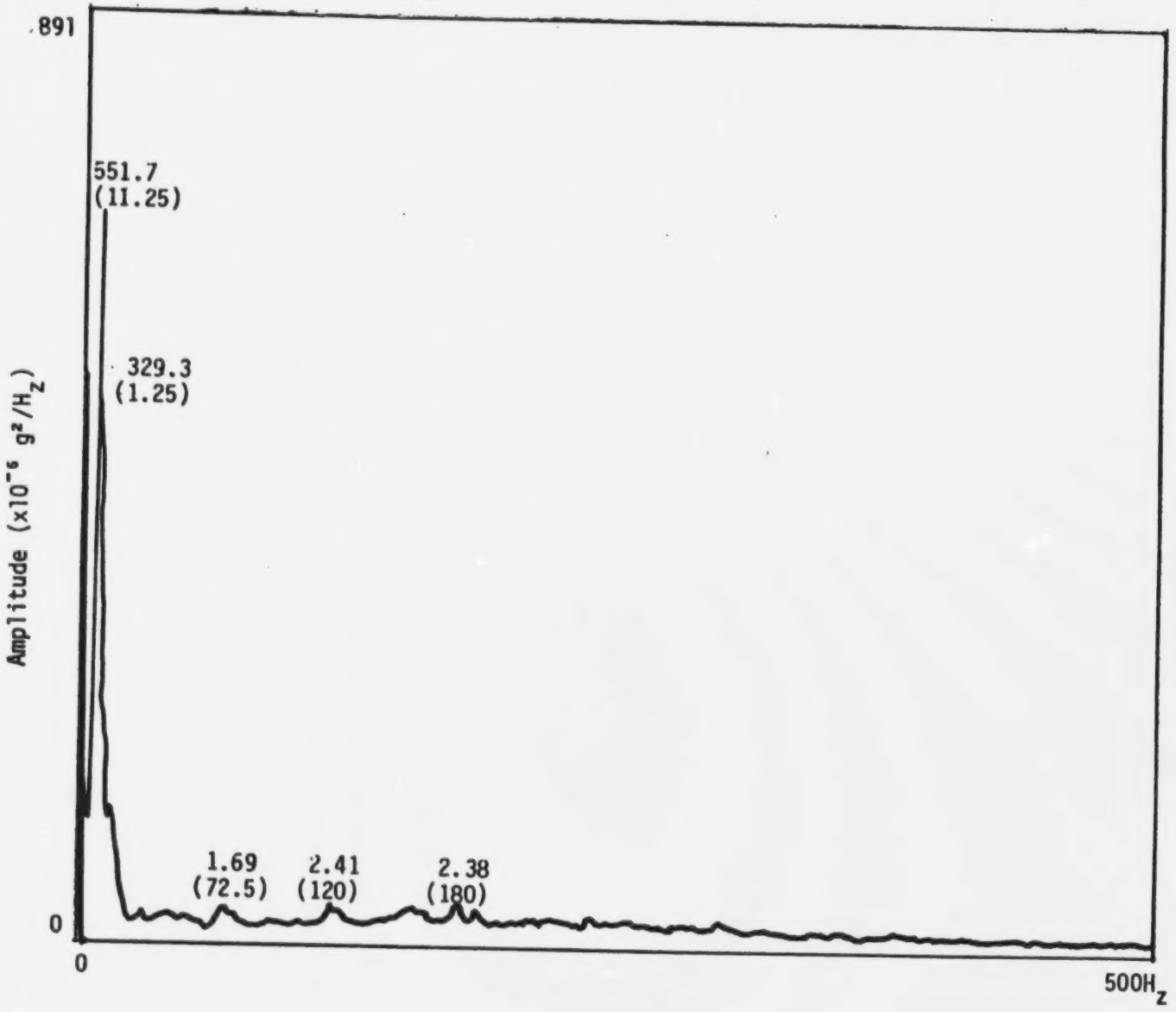


FIGURE 6.2b PEAK AVERAGE ACCELERATION SPECTRUM

Event :CRASH REVERSAL IN OPEN WATER
Vessel : USCGC POLAR SEA Test Time : 81:01:29:13:58
Sensor : 'BOW HEAVE' Calibration: 1.2500 (g'/v)
Frequency: 500 (Hz)

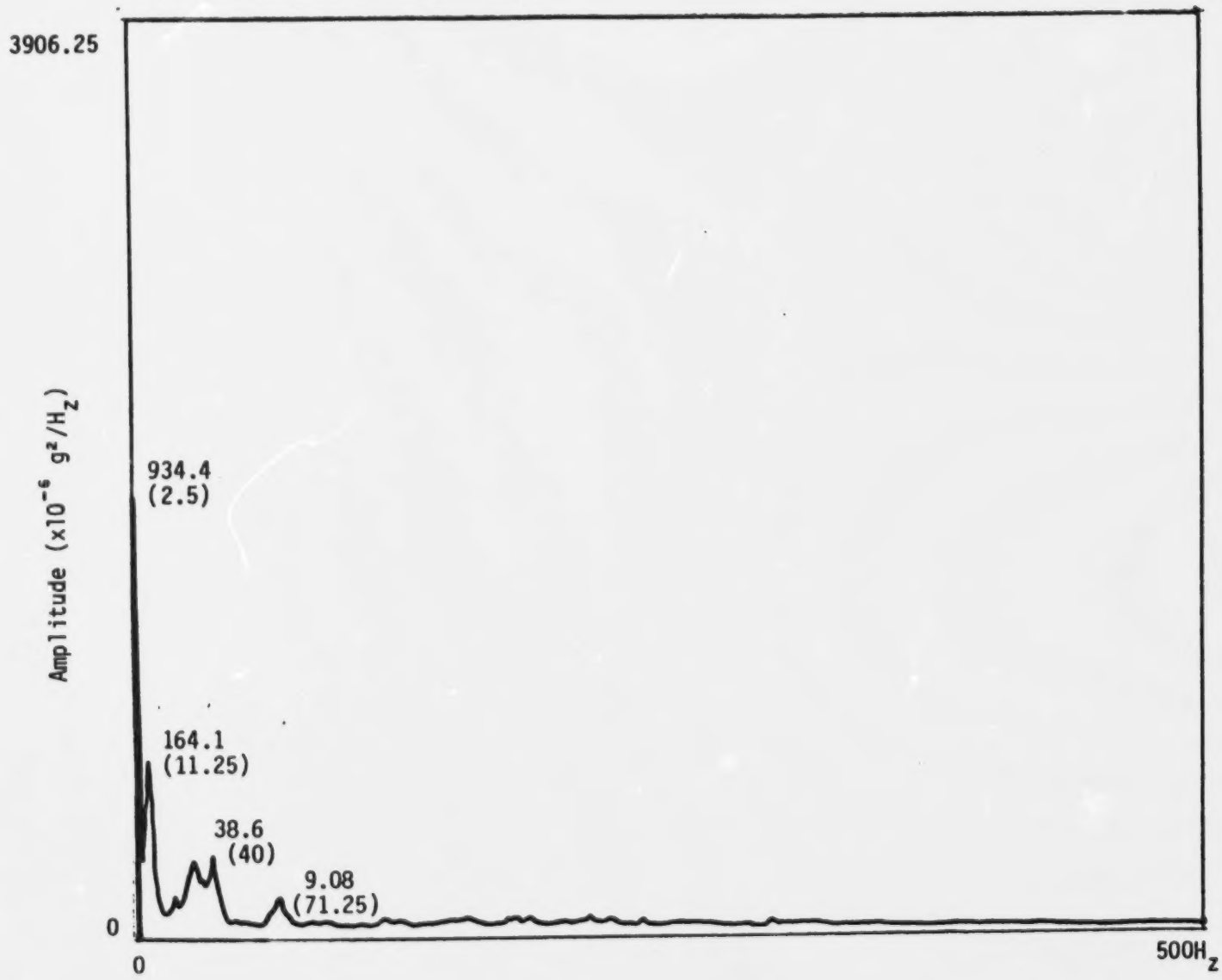


FIGURE 6.2c PEAK AVERAGE ACCELERATION SPECTRUM

Event :CRASH REVERSAL IN OPEN WATER
Vessel : USCGC POLAR SEA
Sensor : 'SURGE'
Frequency: 500 (Hz)
Test Time : 81:01:29:13:58
Calibration: .9591 (g'/v)

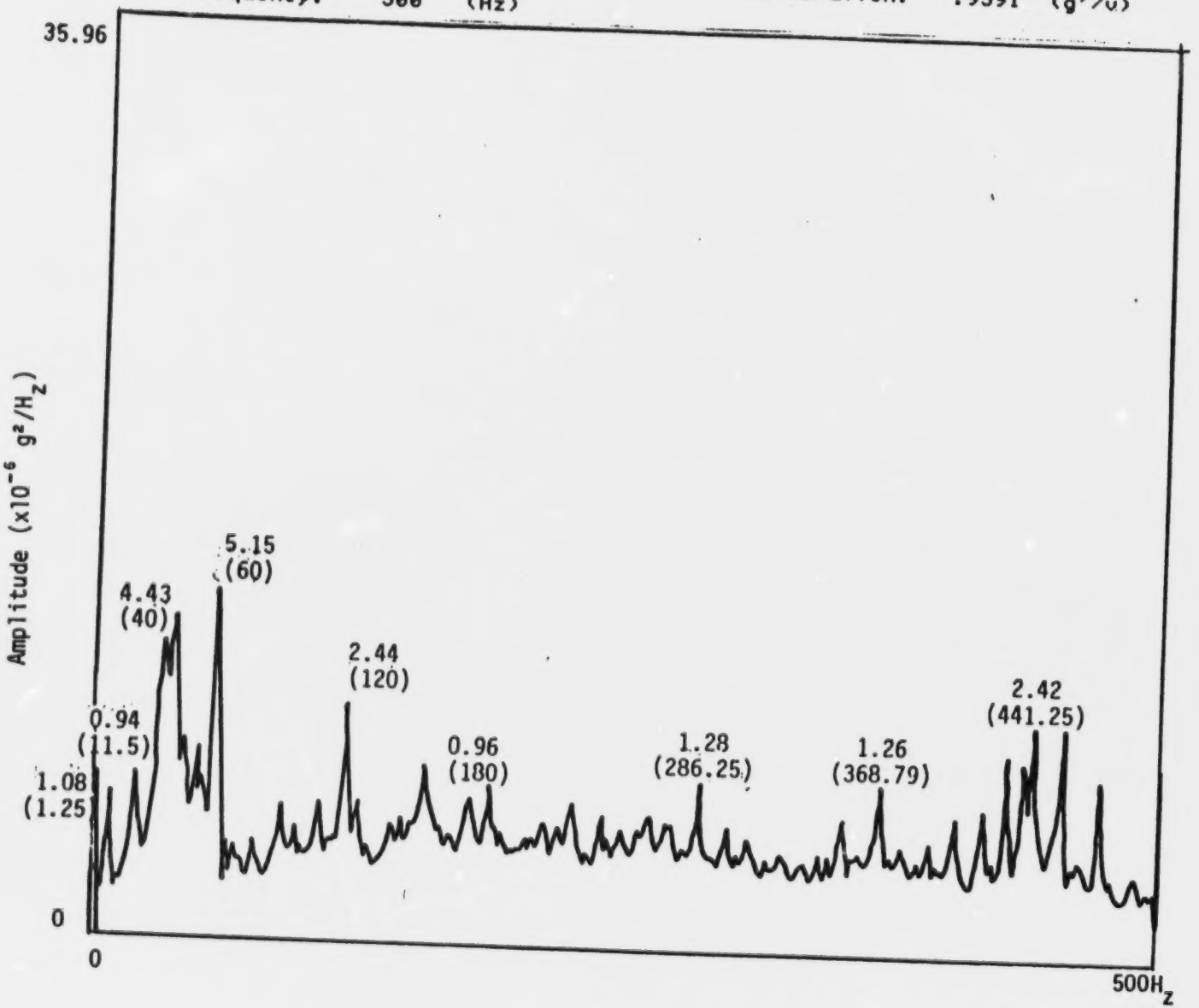


FIGURE 6.2d PEAK AVERAGE ACCELERATION SPECTRUM

Event :CRASH REVERSAL IN OPEN WATER
Vessel : USCGC POLAR SEA
Sensor : 'SWAY'
Frequency: 500 (Hz)
Test Time : 81:01:29:13:58
Calibration: .9547 (g'/v)

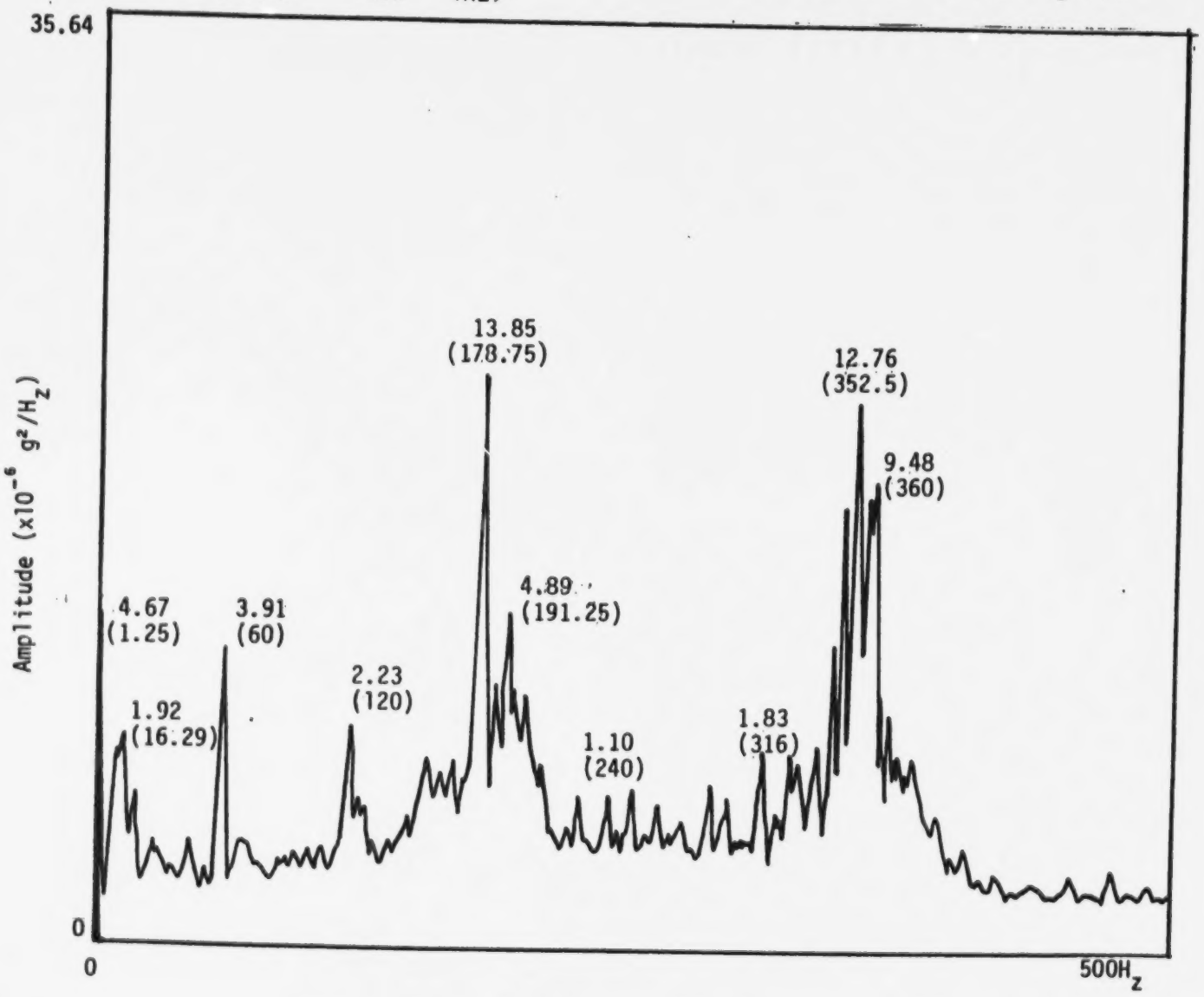


FIGURE 6.2e PEAK AVERAGE ACCELERATION SPECTRUM

Event : CRASH REVERSAL IN OPEN WATER
Vessel : USCGC POLAR SEA
Sensor : 'HEAVE'
Frequency: 500 (Hz)
Test Time : 81:01:29:13:58
Calibration: .9603 (g'/v)

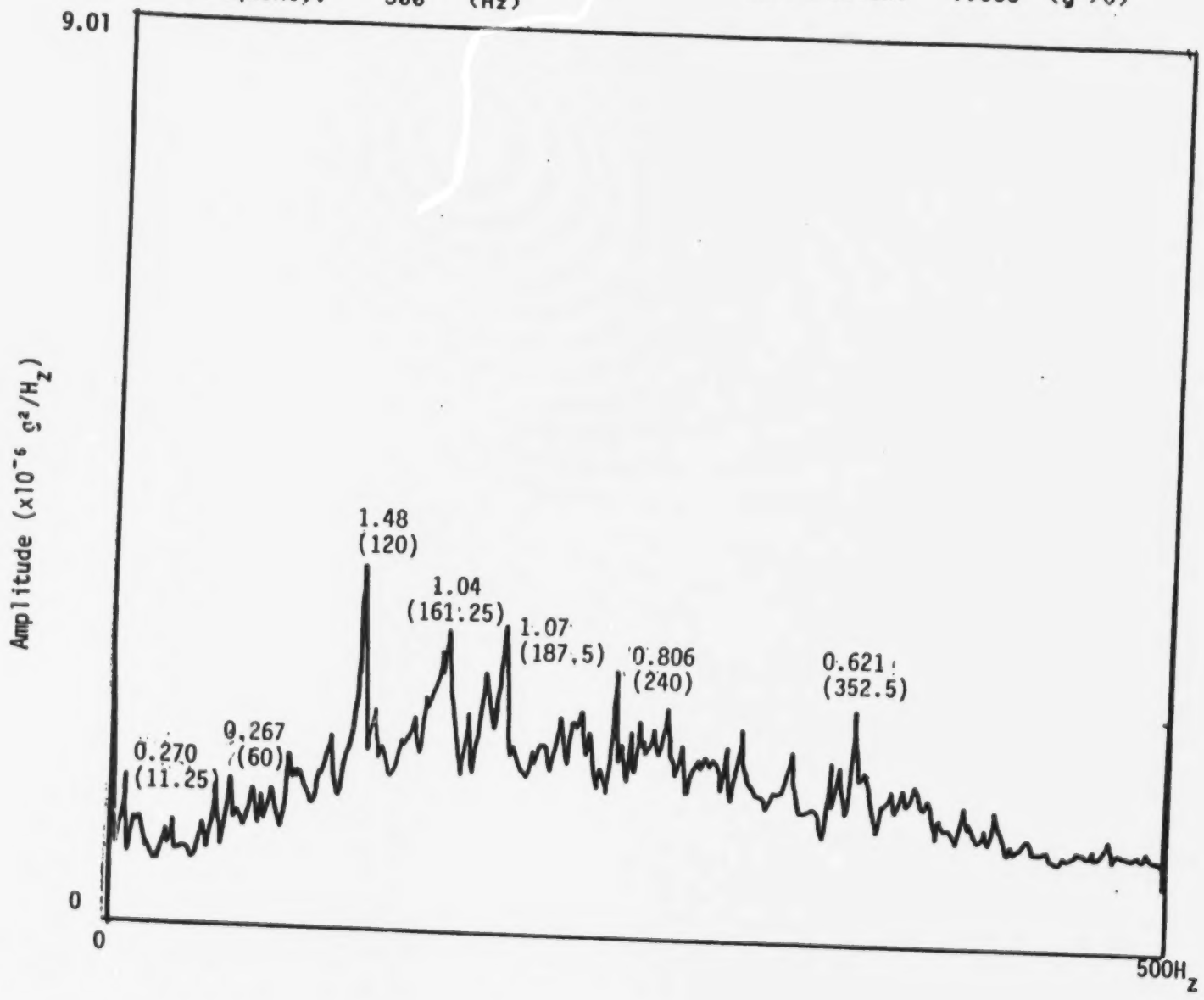


FIGURE 6.2f PEAK AVERAGE ACCELERATION SPECTRUM

Event :CRASH REVERSAL IN OPEN WATER
Vessel : USCGC POLAR SEA
Sensor : 'AFT SURGE'
Frequency: 500 (Hz)
Test Time : 81:01:29:13:58
Calibration: 1.1834 (g'/v)

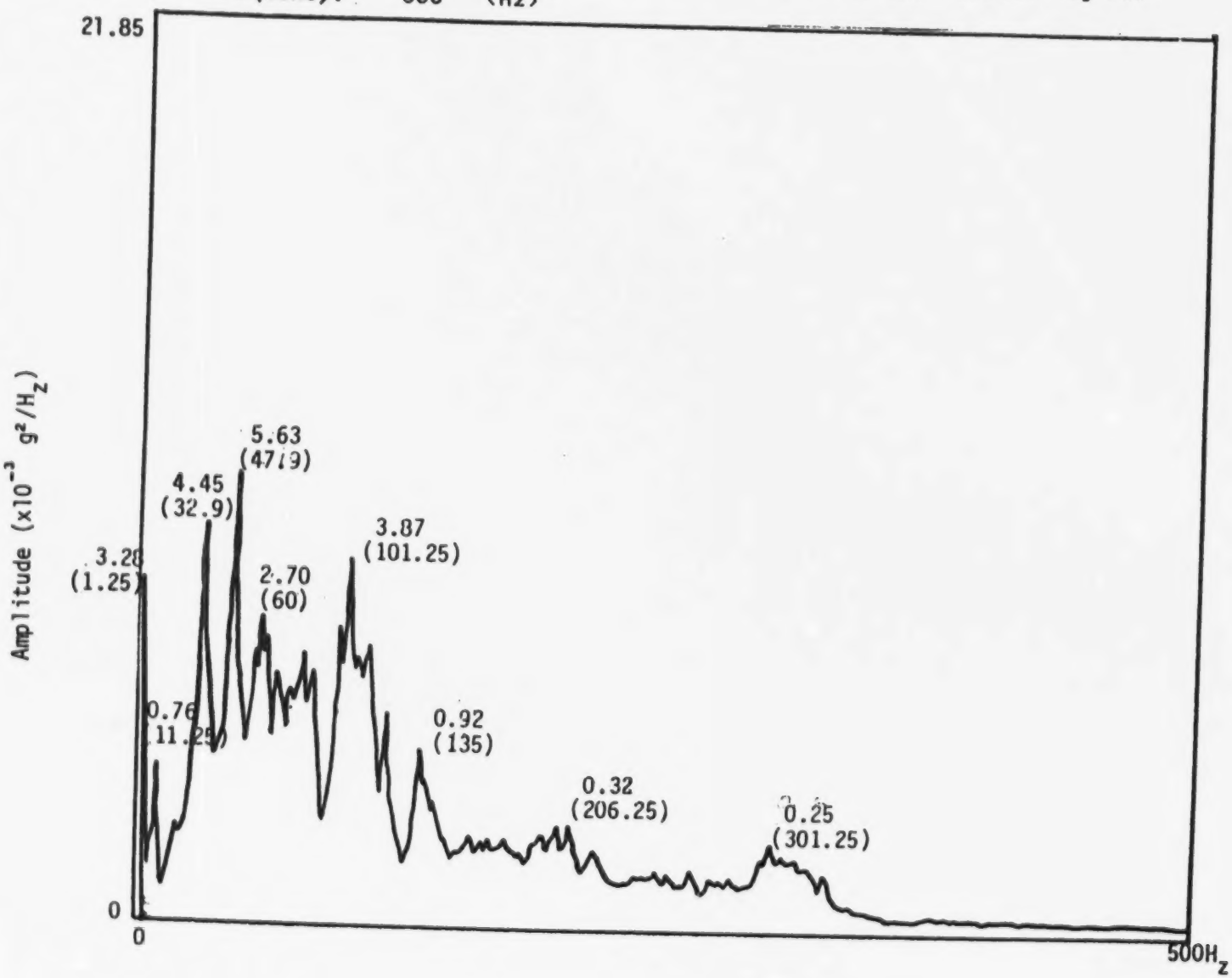


FIGURE 6.2g PEAK AVERAGE ACCELERATION SPECTRUM

Event :CRASH REVERSAL IN OPEN WATER
Vessel : USCGC POLAR SEA
Sensor : 'AFT SWAY'
Frequency: 500 (Hz)

Test Time : 81:01:29:13:58
Calibration: 1.2270 (g'/v)

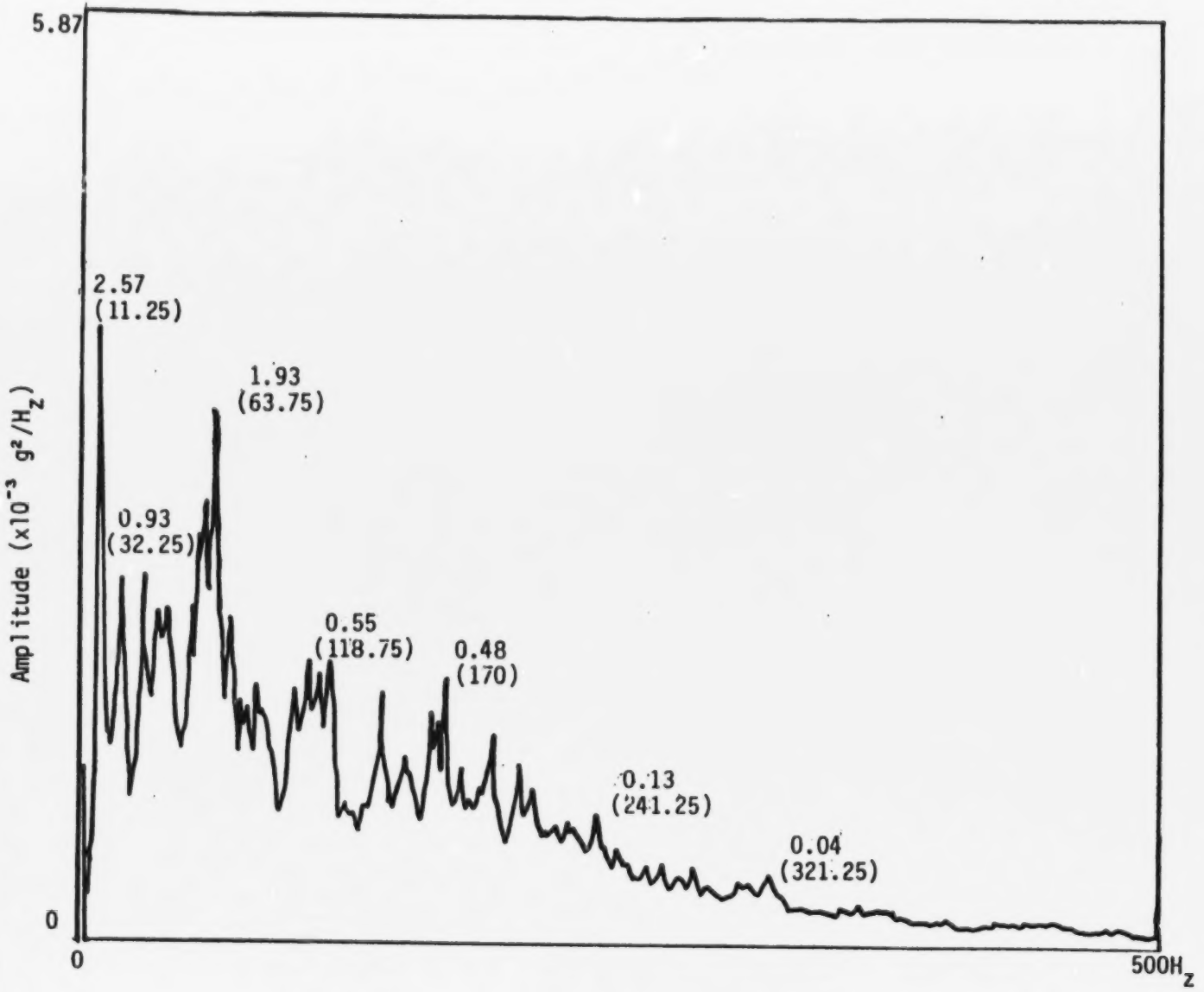


FIGURE 6.2h PEAK AVERAGE ACCELERATION SPECTRUM

Event :CRASH REVERSAL IN OPEN WATER
Vessel : USCGC POLAR SEA
Sensor : 'AFT HEAVE'
Frequency: 500 (Hz)

Test Time : 81:01:29:13:58
Calibration: 1.2345 (g'/v)

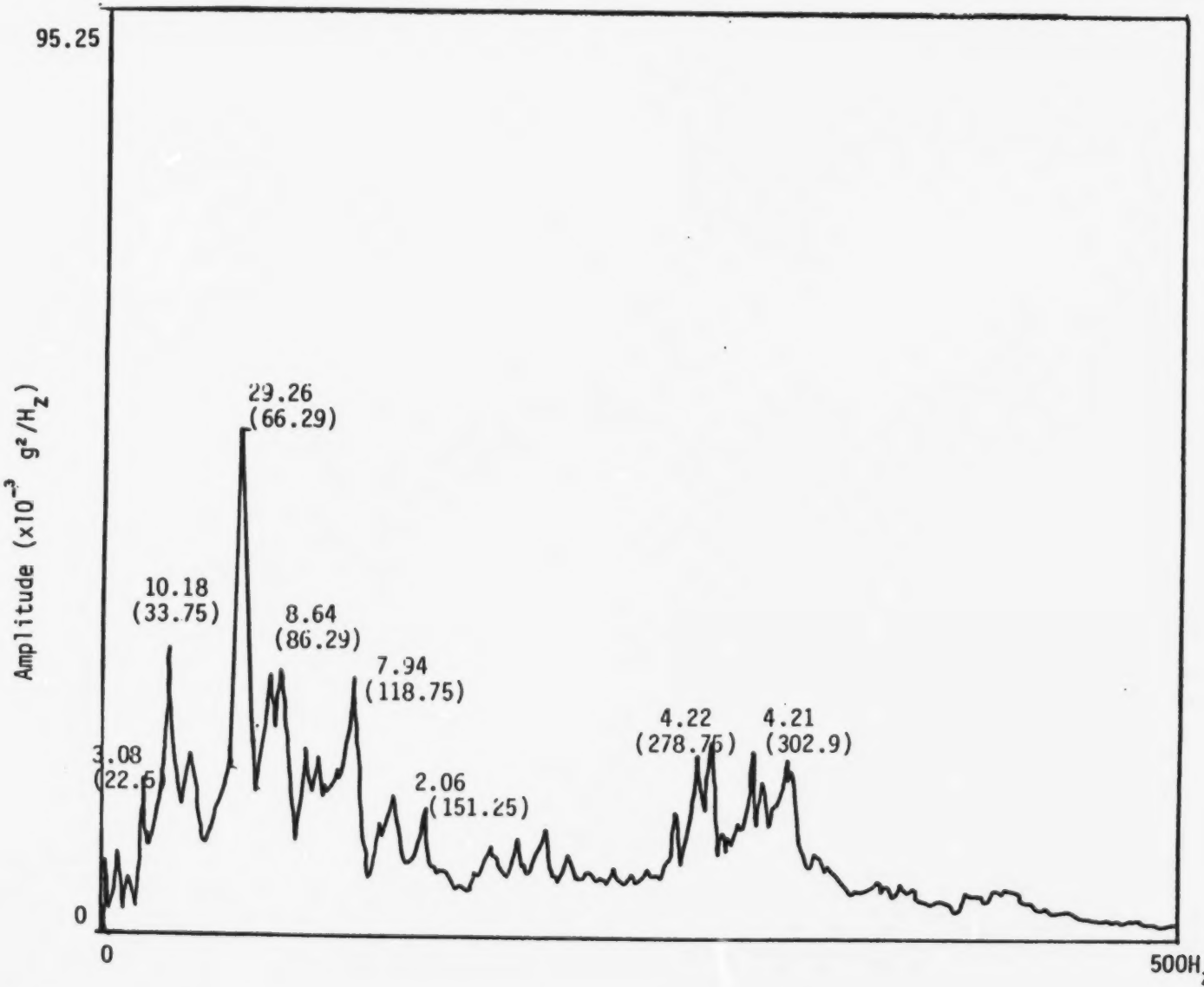


FIGURE 6.3a PEAK AVERAGE ACCELERATION SPECTRUM

Event :BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'BOW SWAY'
Frequency: 50 (Hz)

Test Time : 81:01:31:13:02
Calibration: 1.1940 (g'/v)

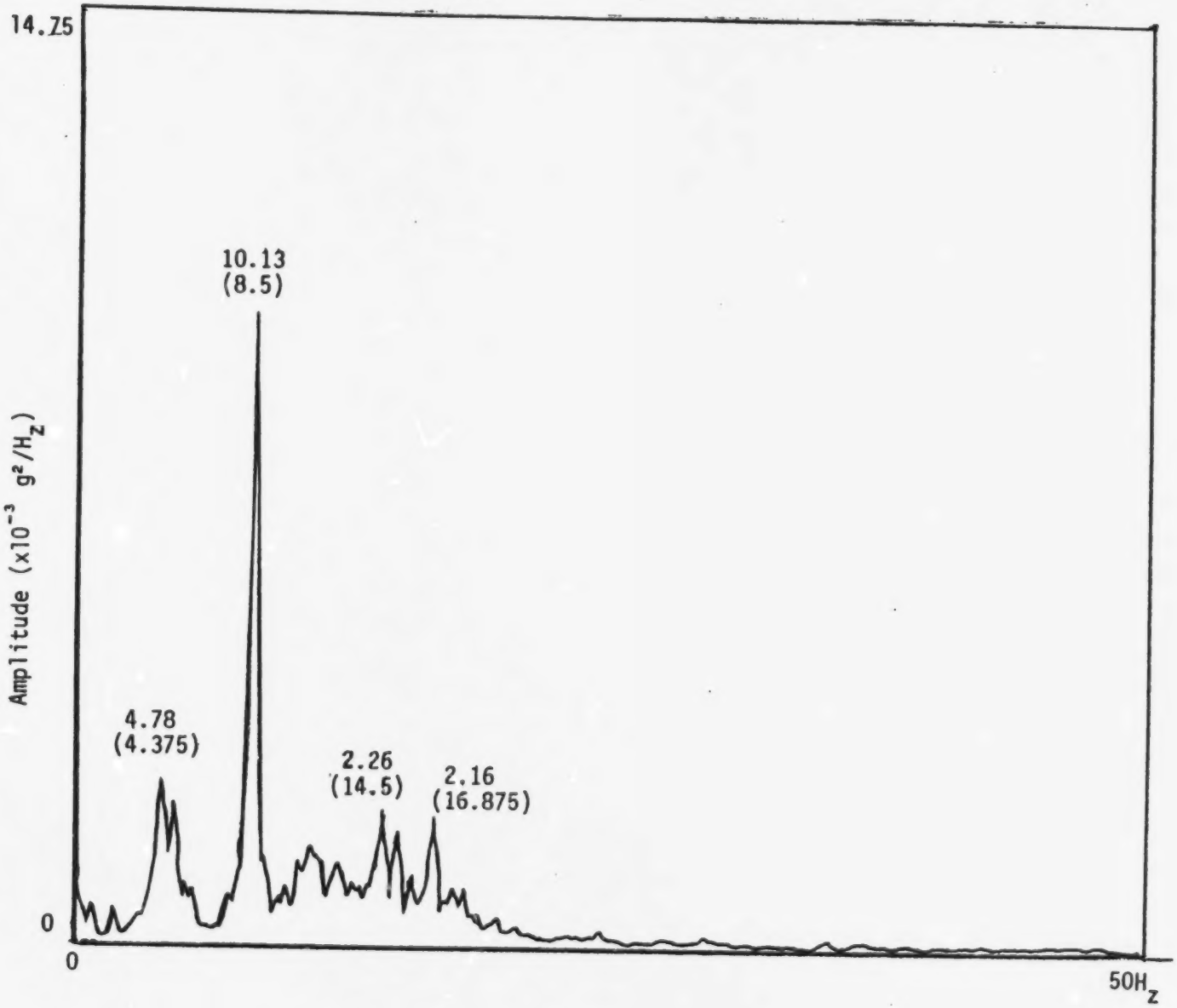


FIGURE 6.3b PEAK AVERAGE ACCELERATION SPECTRUM

Event :BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'BOW HEAVE'
Frequency: 50 (Hz)

Test Time : 81:01:31:13:02
Calibration: 1.2500 (g'/v)

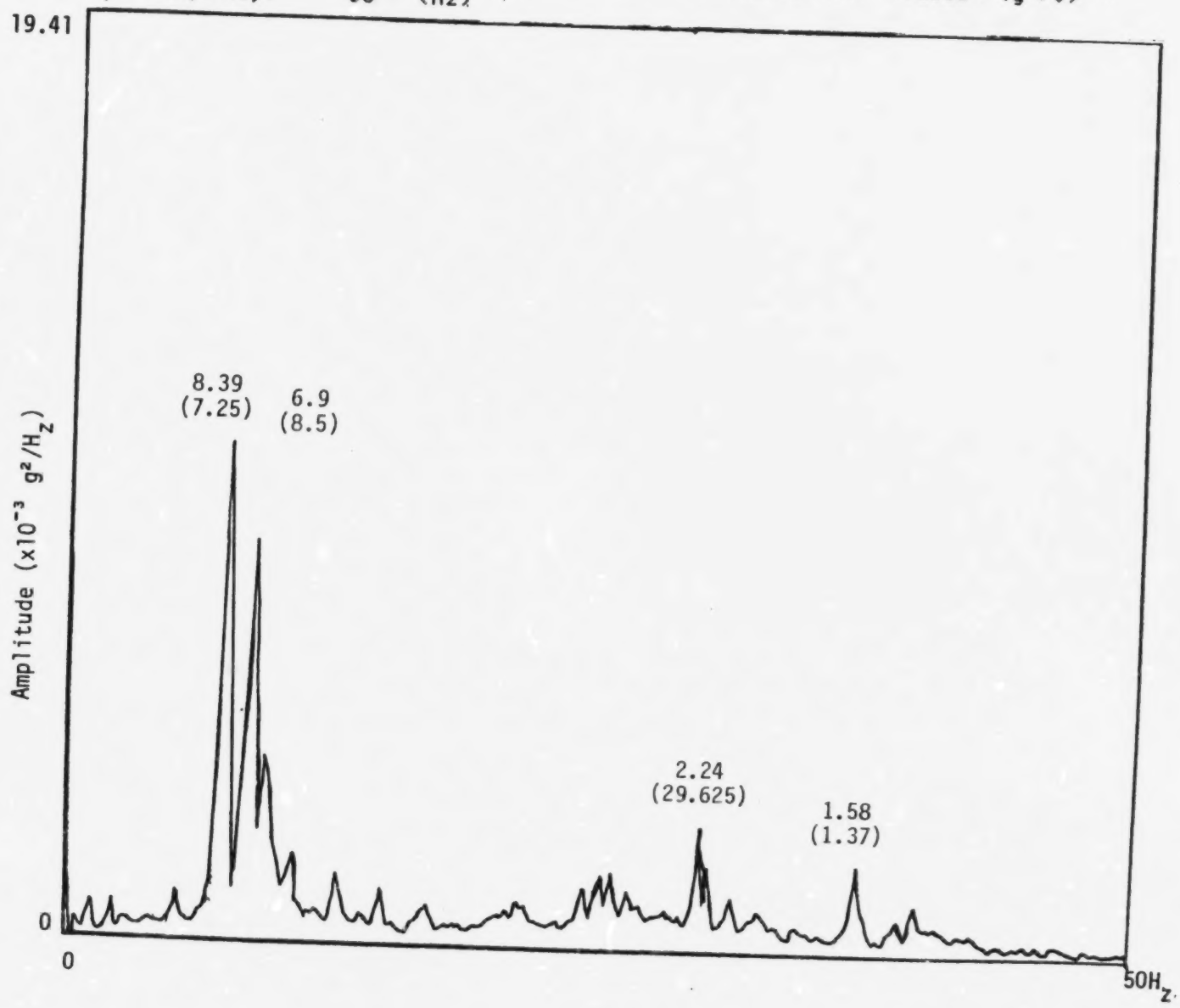


FIGURE 6.3c PEAK AVERAGE ACCELERATION SPECTRUM

Event :BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'SURGE'
Frequency: 50 (Hz)

Test Time : 81:01:31:13:02
Calibration: .9591 (g'/v)

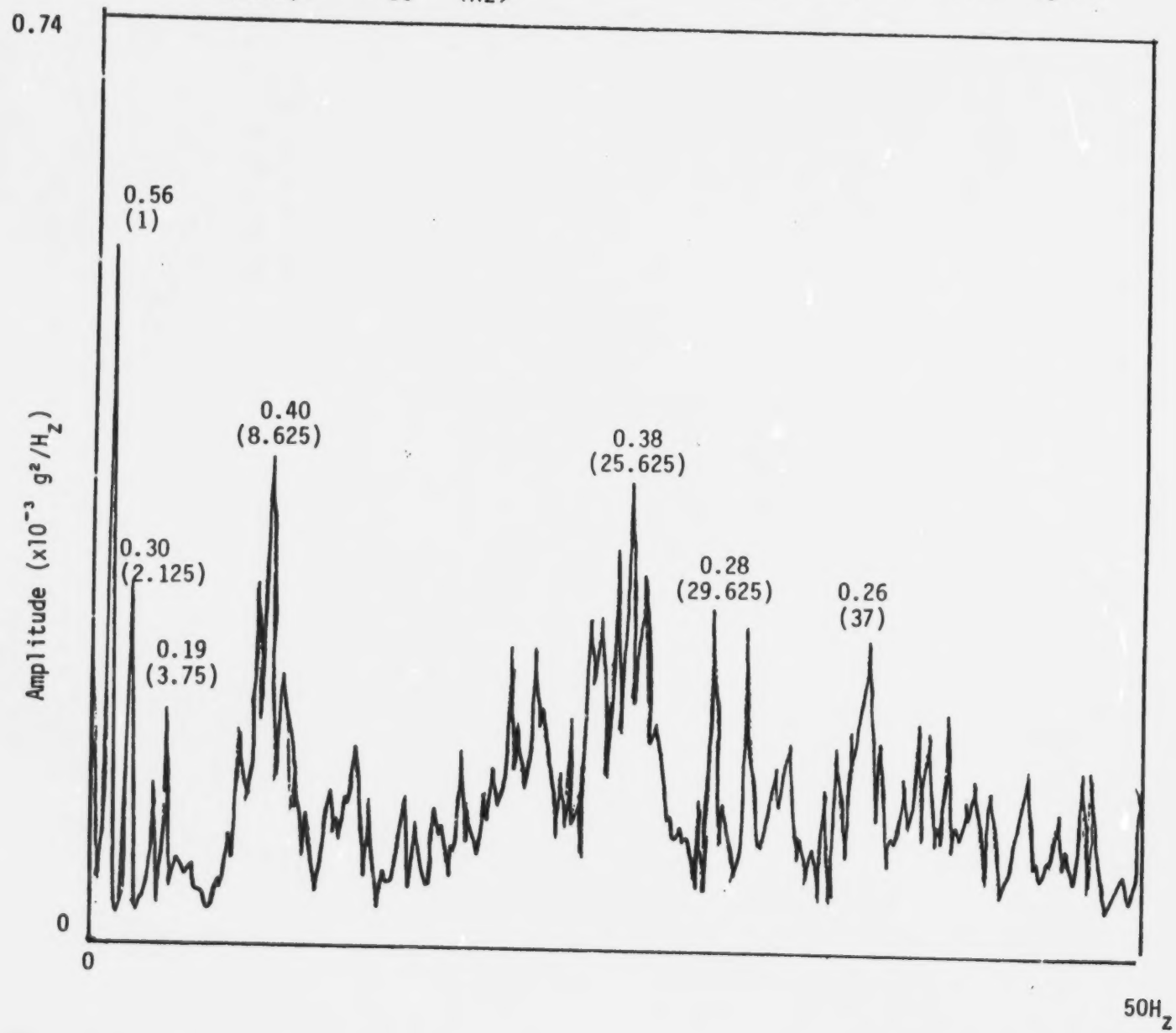


FIGURE 6.3d PEAK AVERAGE ACCELERATION SPECTRUM

Event :BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'SWAY'
Frequency: 50 (Hz)

Test Time : 81:01:31:13:02
Calibration: .9547 (g'/v)

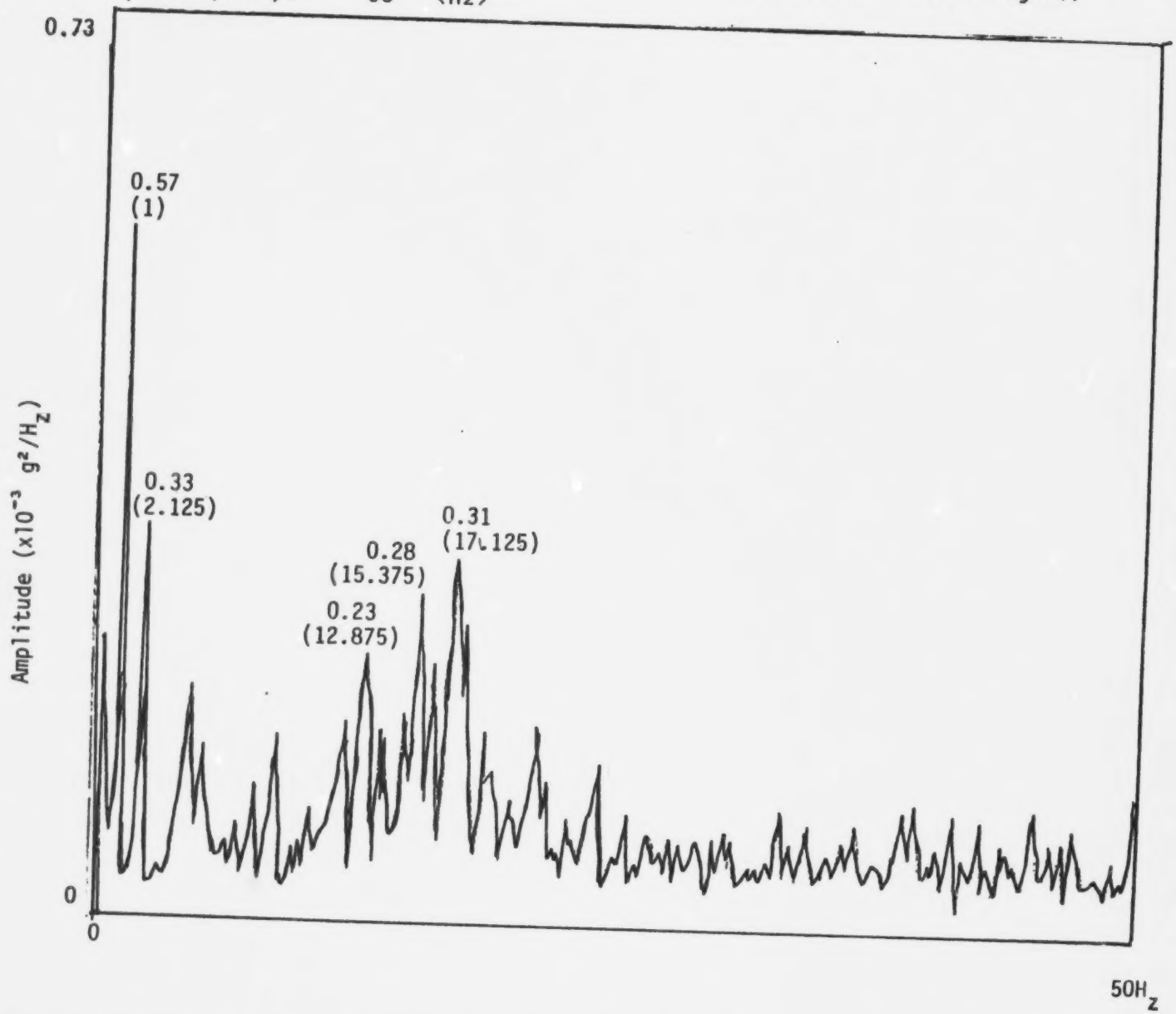


FIGURE 6.3e TEST TIME: 01:31:13:02

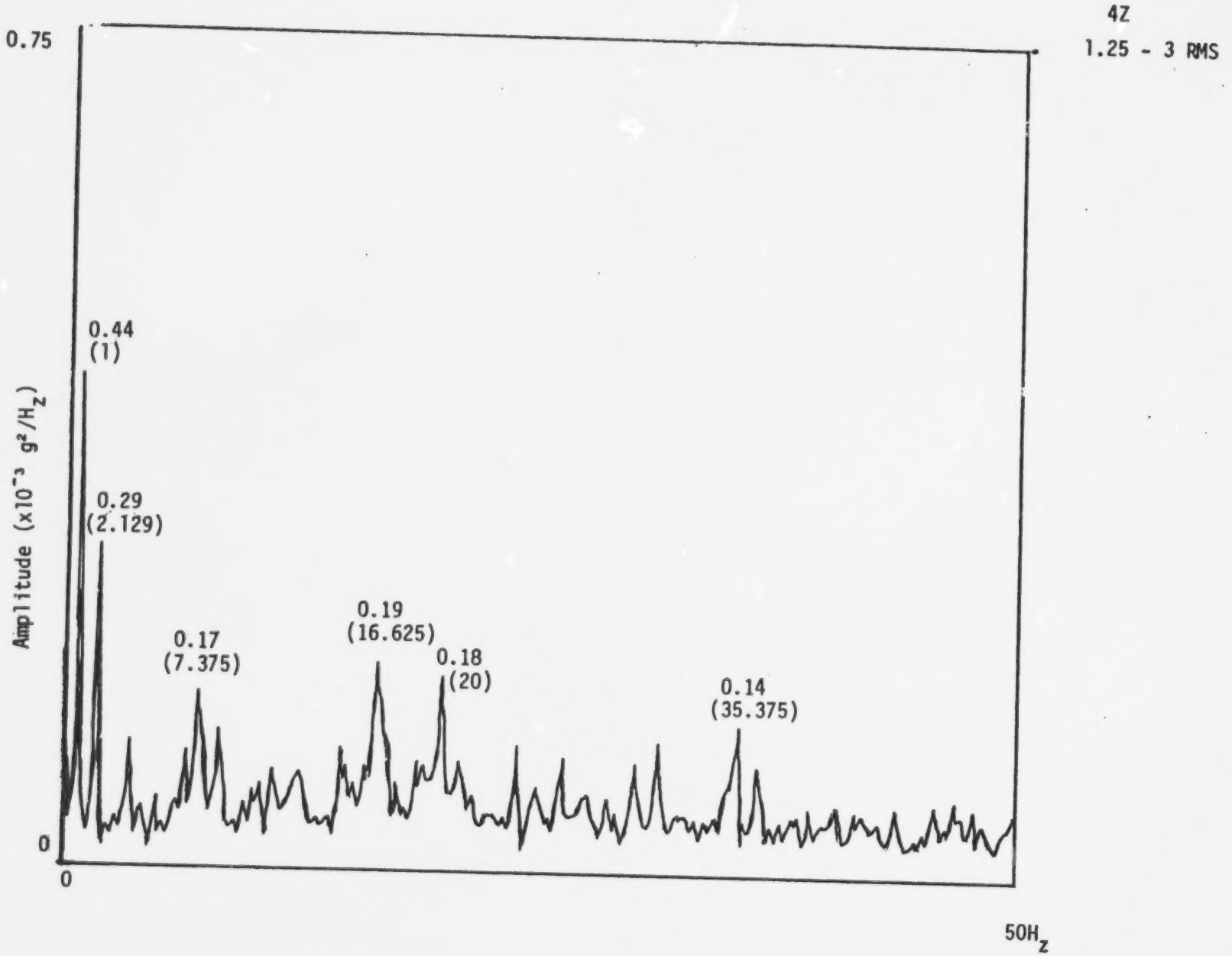


FIGURE 6.3f PEAK AVERAGE ACCELERATION SPECTRUM

Event :BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'AFT SURGE'
Frequency: 50 (Hz)

Test Time : 81:01:31:13:02
Calibration: 1.1834 (g'/v)

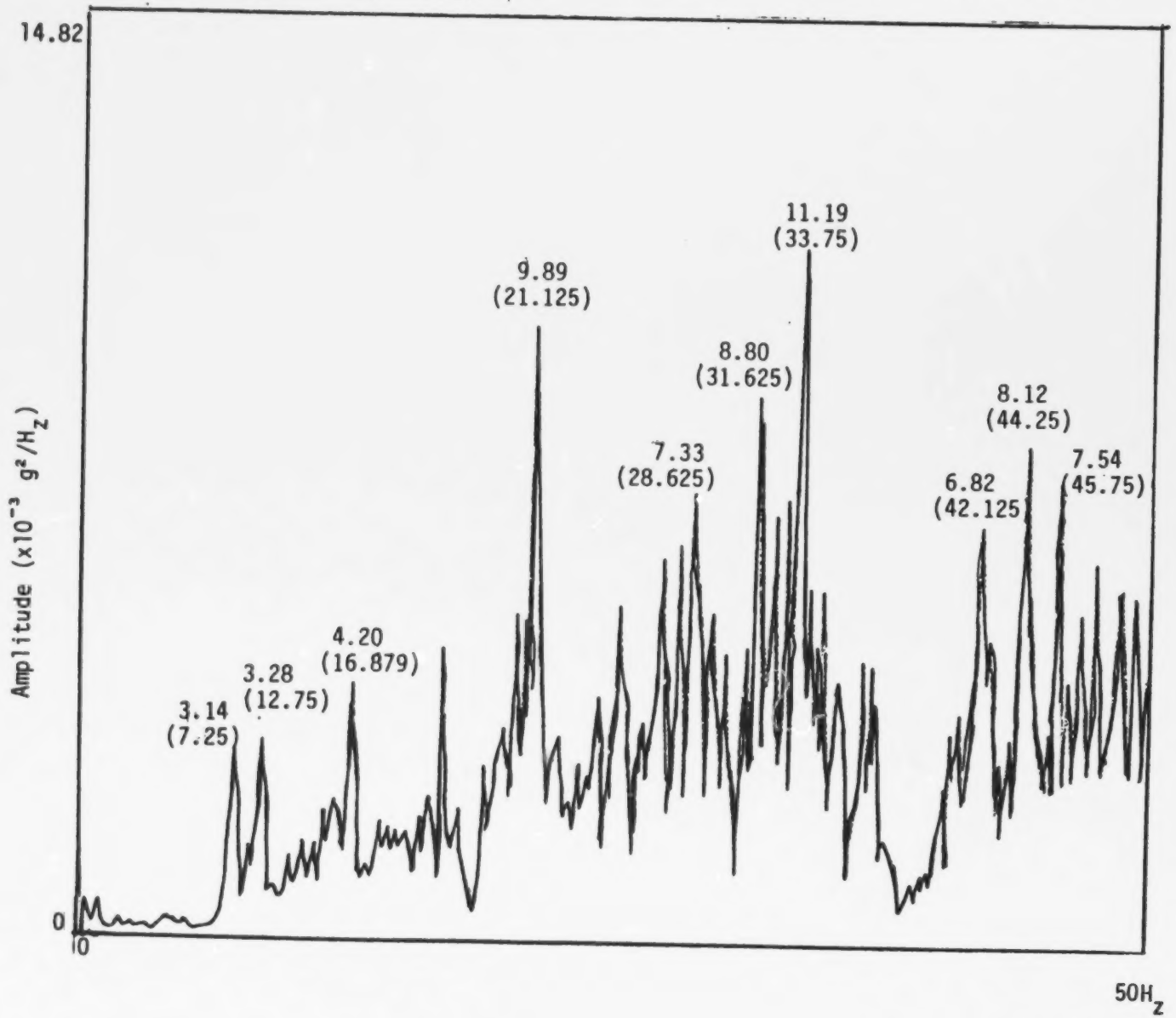


FIGURE 6.3g PEAK AVERAGE ACCELERATION SPECTRUM

Event : BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'AFT SWAY'
Frequency: 50 (Hz)

Test Time : 81:01:31:13:02
Calibration: 1.2270 (g'/v)

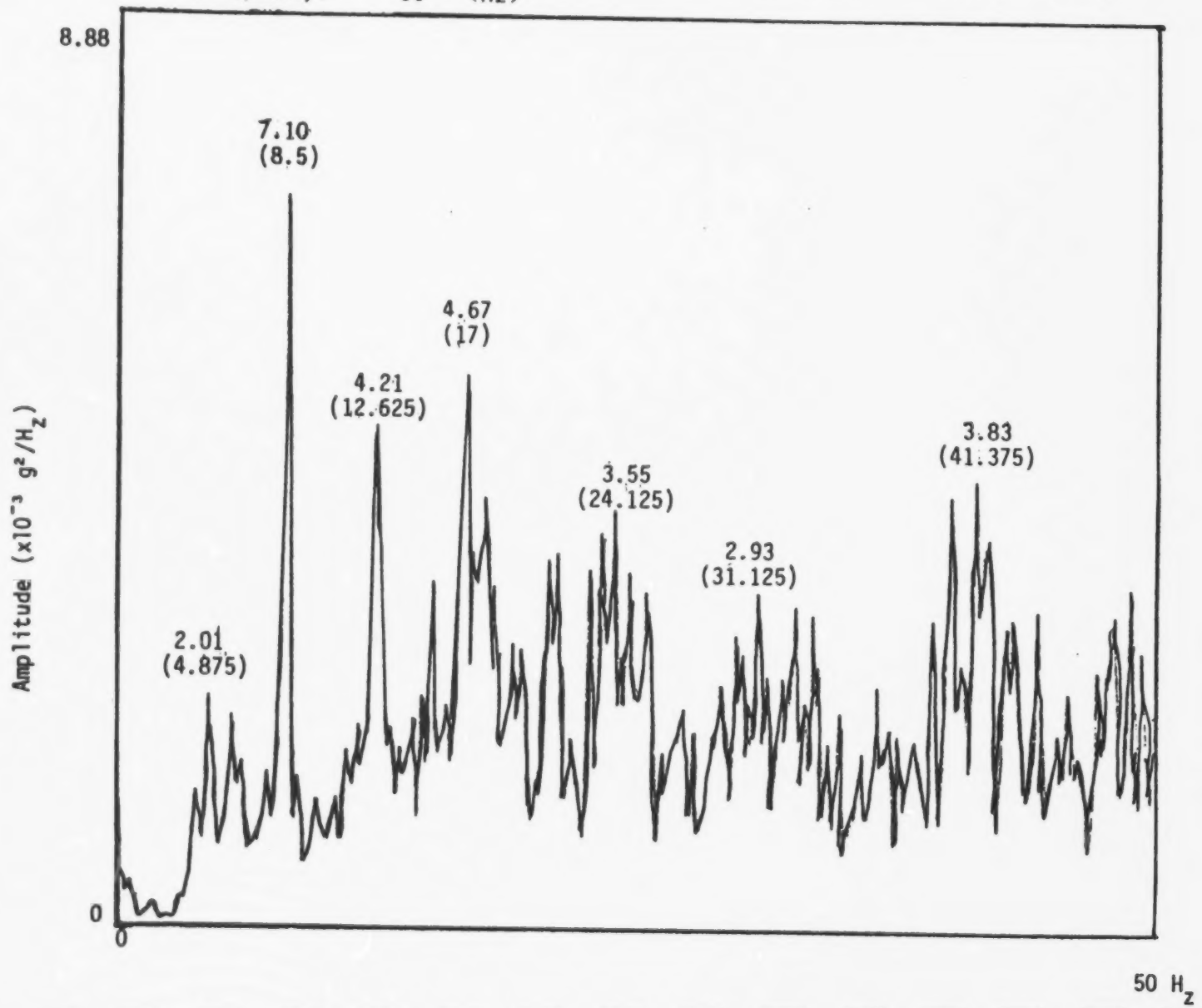


FIGURE 6.3h PEAK AVERAGE ACCELERATION SPECTRUM

Event : BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'AFT HEAVE'
Frequency: 50 (Hz)

Test Time : 81:01:31:13:02
Calibration: 1.2345 (g'/v)

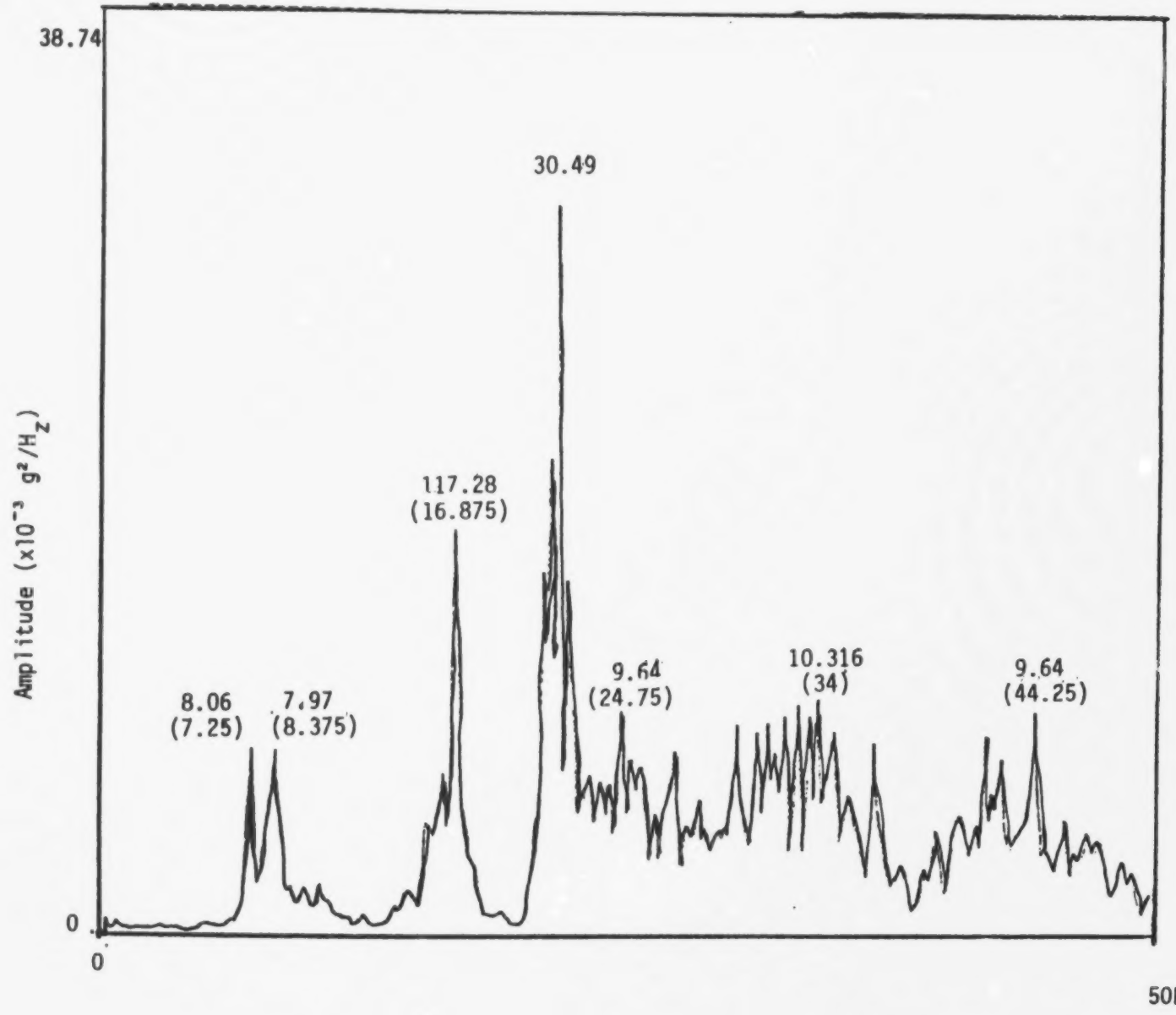


FIGURE 6.4a PEAK AVERAGE ACCELERATION SPECTRUM

Event :BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'BOW SWAY'
Frequency: 500 (Hz)

Test Time : 81:01:31:13:02
Calibration: 1.1940 (g'/v)

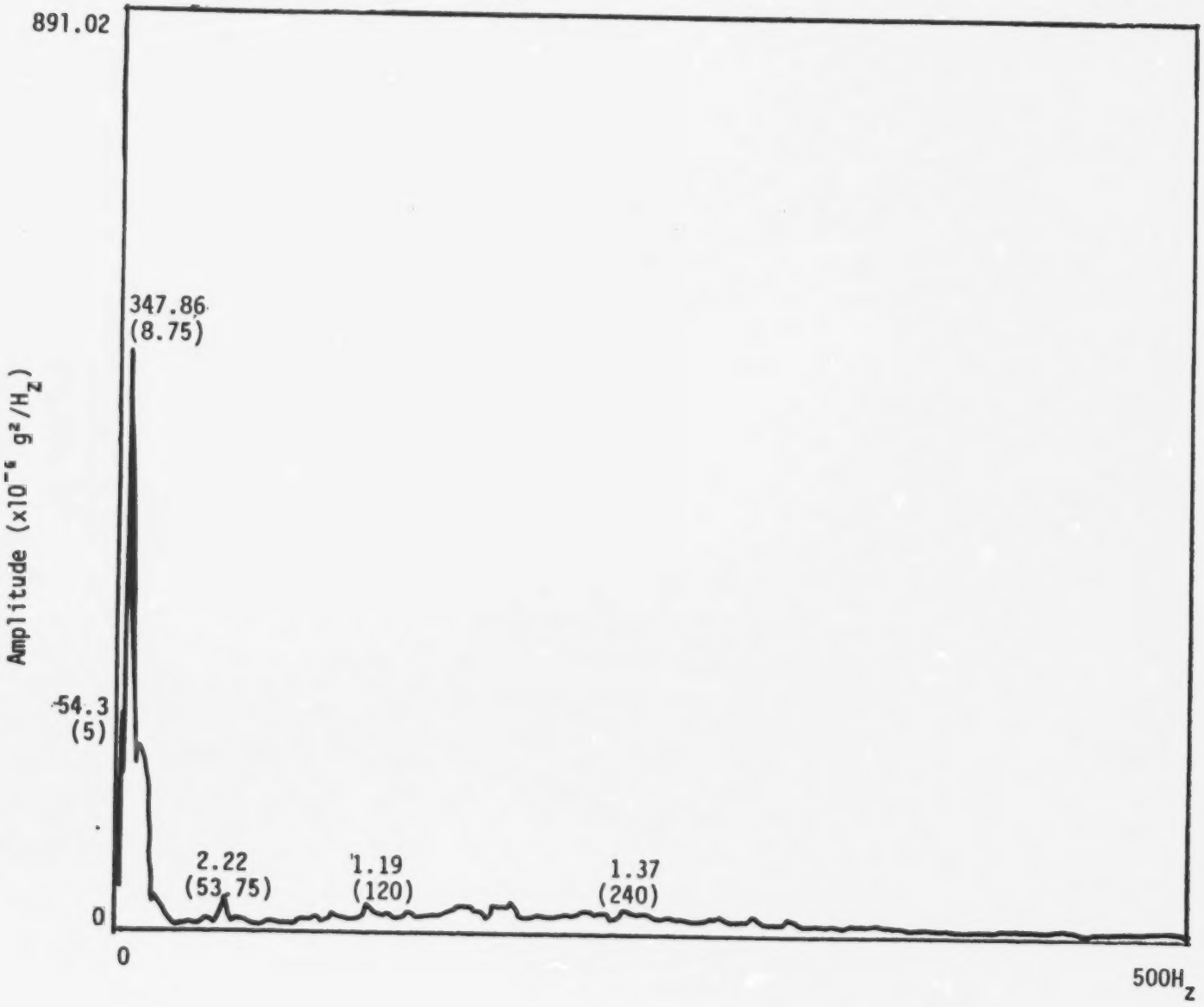


FIGURE 6.4b PEAK AVERAGE ACCELERATION SPECTRUM

Event :BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'BOW HEAVE'
Frequency: 500 (Hz)

Test Time : 81:01:31:13:02
Calibration: 1.2500 (g'/v)

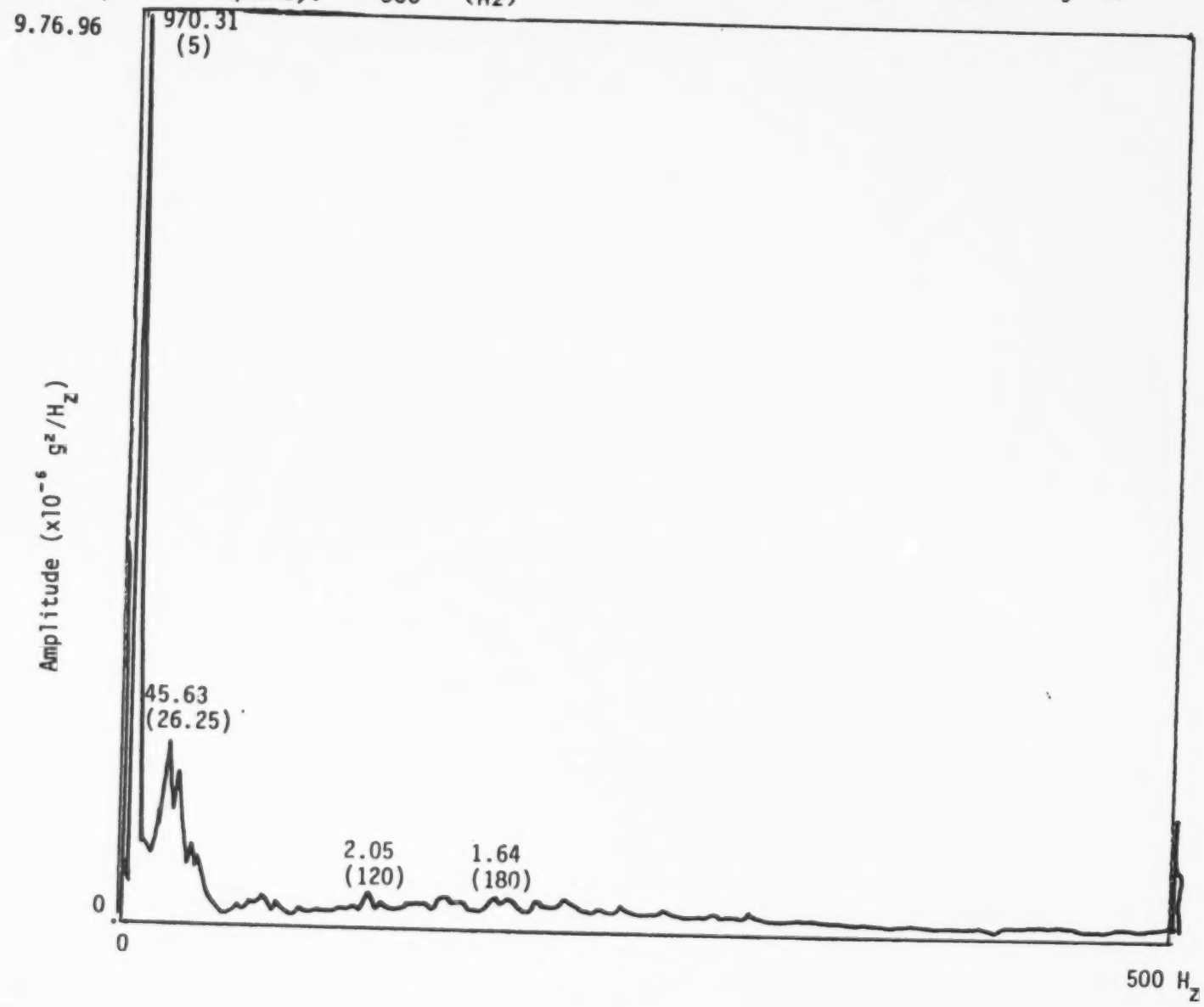


FIGURE 6.4c PEAK AVERAGE ACCELERATION SPECTRUM

Event :BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'SURGE'
Frequency: 500 (Hz)

Test Time : 81:01:31:13:02
Calibration: .9591 (g'/v)

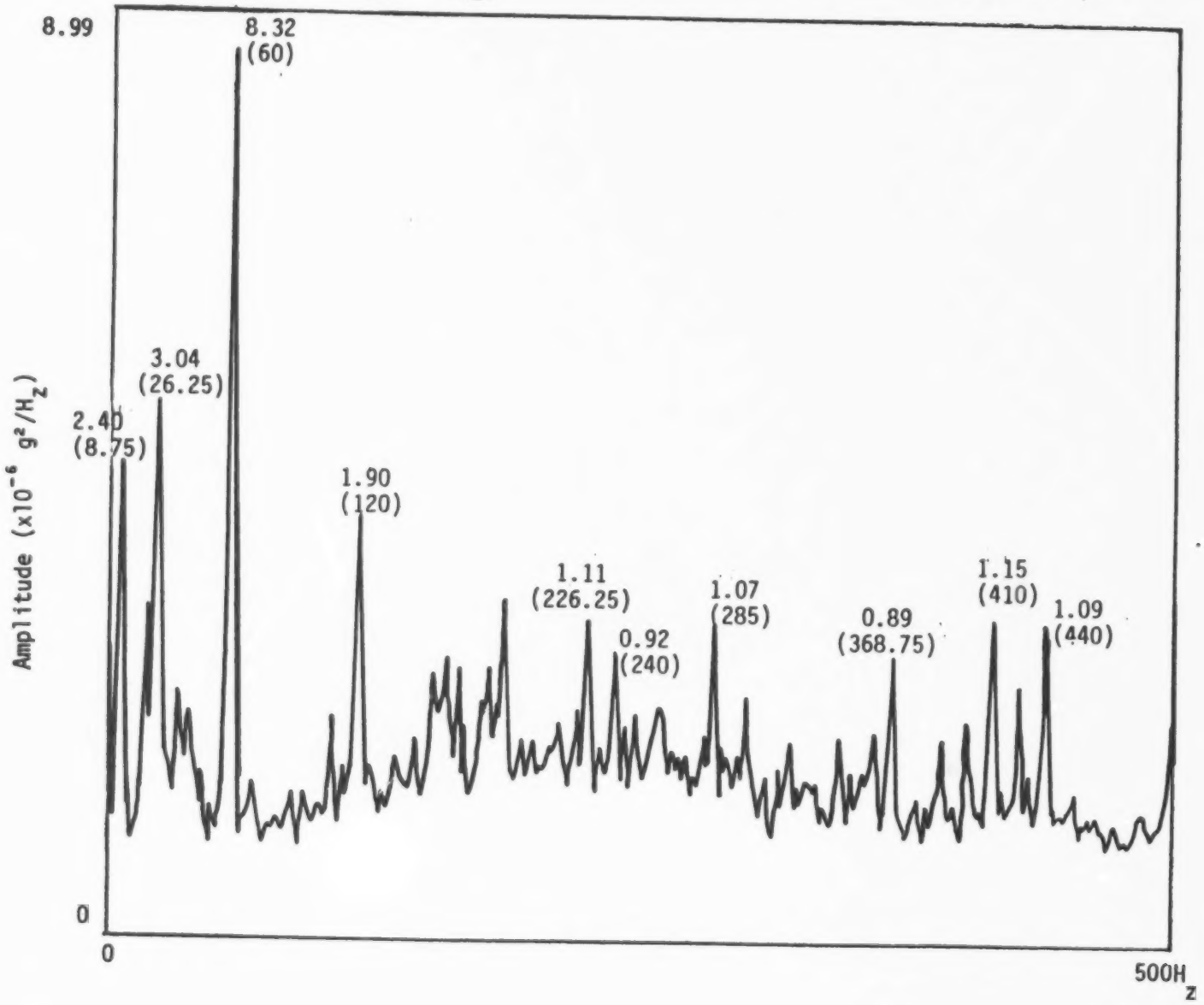


FIGURE 6.4d PEAK AVERAGE ACCELERATION SPECTRUM

Event :BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'SWAY'
Frequency: 500 (Hz)

Test Time : 81:01:31:13:02
Calibration: .9547 (g'/v)

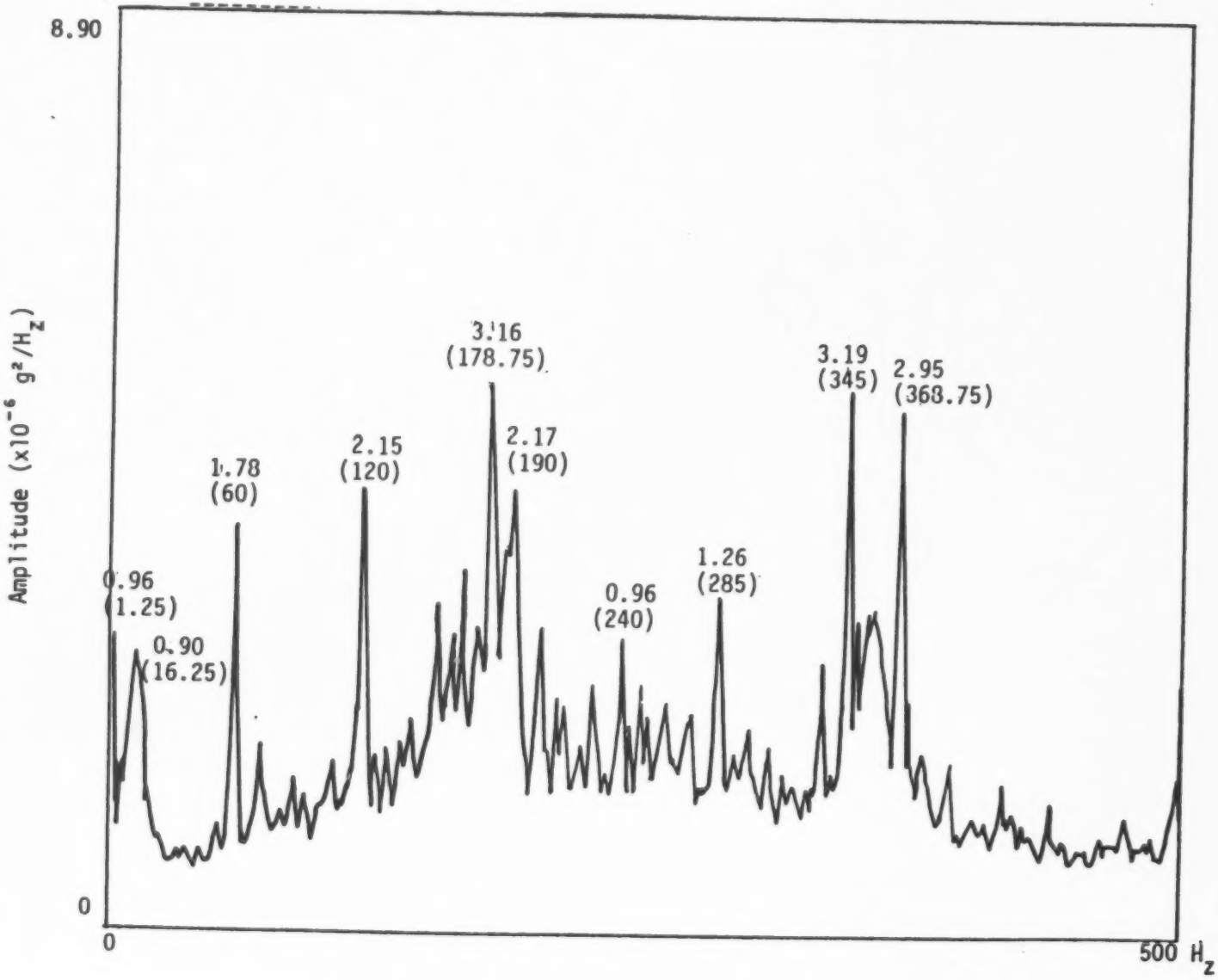


FIGURE 6.4e PEAK AVERAGE ACCELERATION SPECTRUM

Event :BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'HEAVE'
Frequency: 500 (Hz)

Test Time : 81:01:31:13:02
Calibration: .9603 (g''/v)

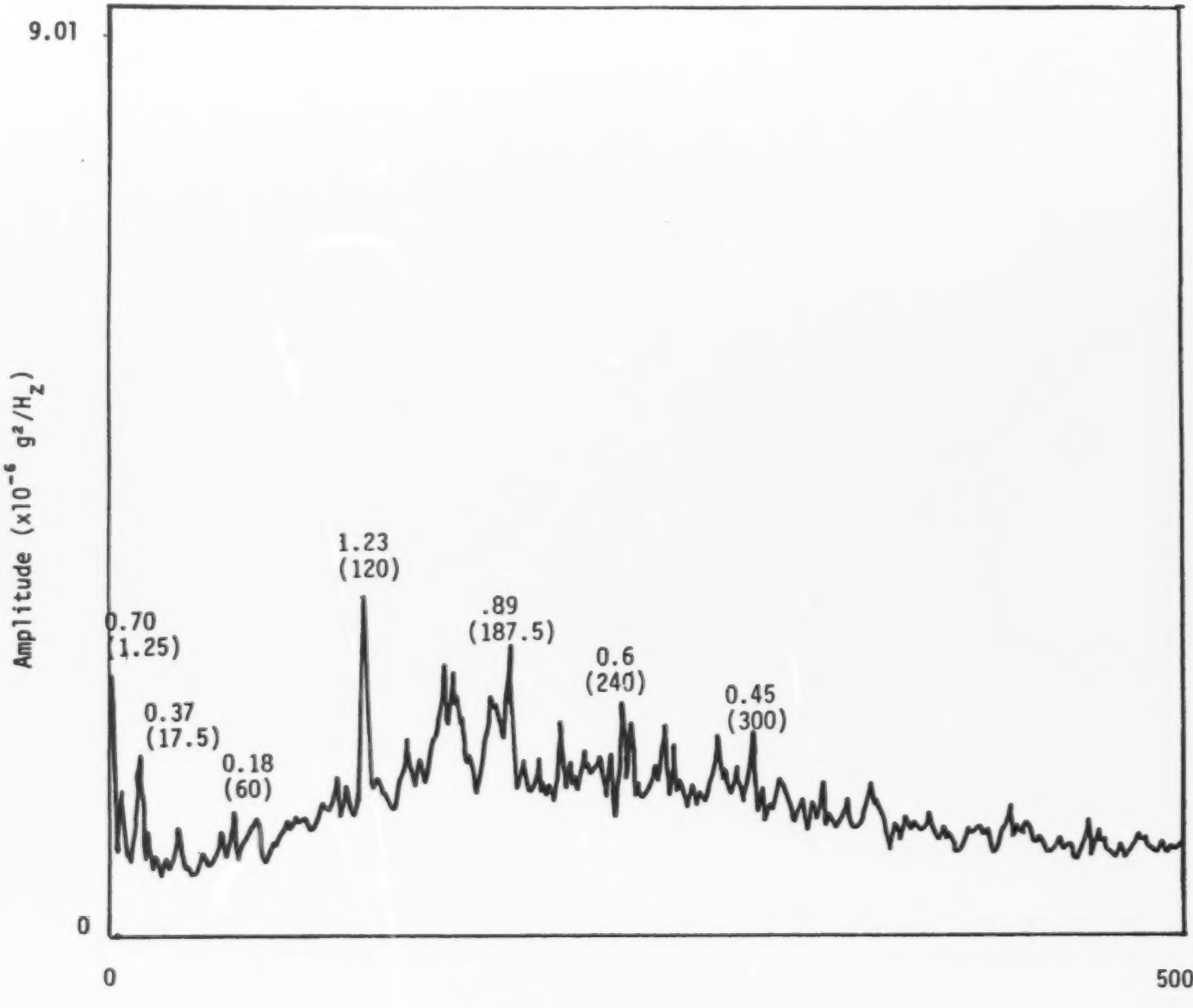


FIGURE 6.4f PEAK AVERAGE ACCELERATION SPECTRUM

Event :BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'AFT SURGE'
Frequency: 500 (Hz)

Test Time : 81:01:31:13:02
Calibration: 1.1834 (g'/v)

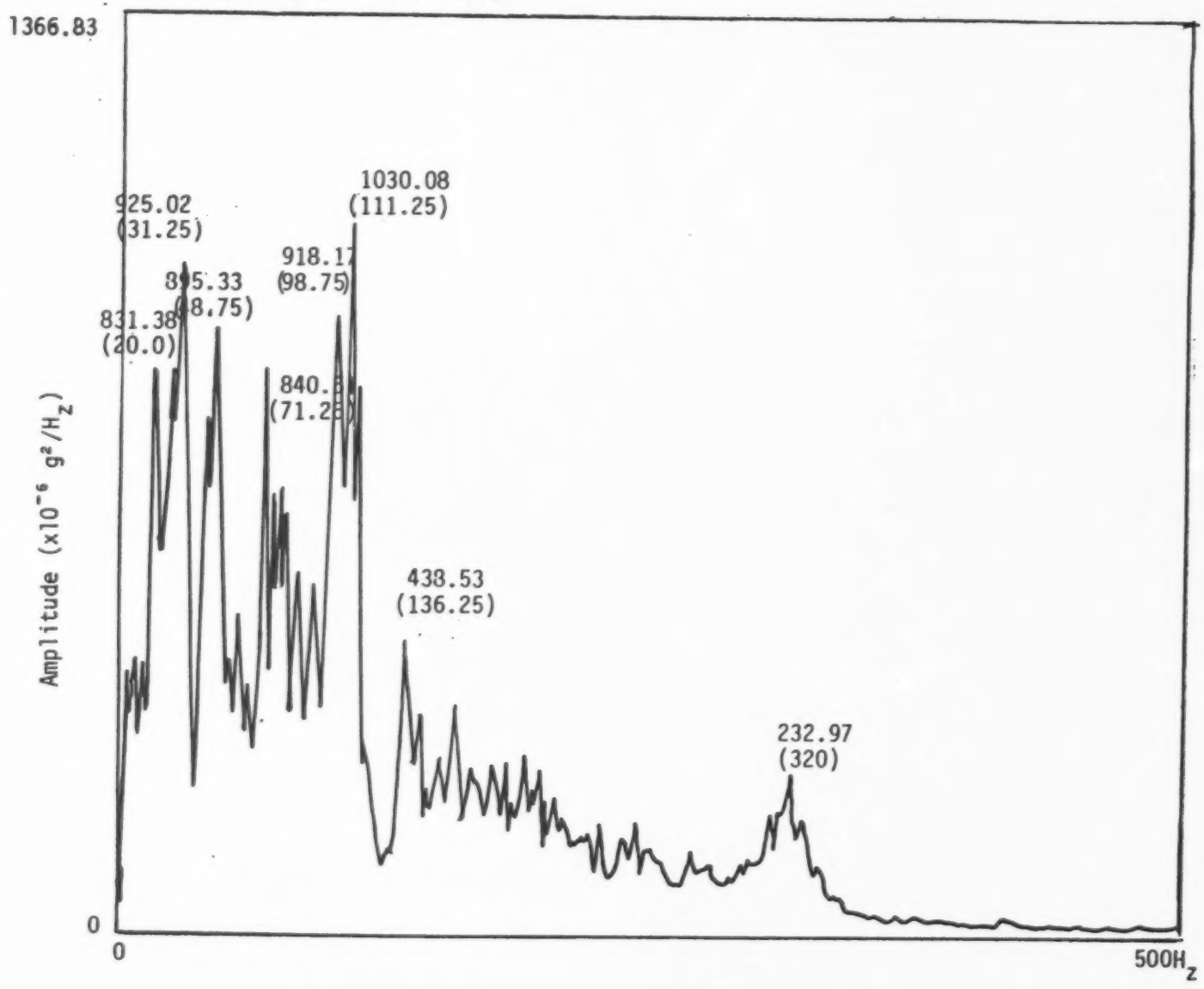


FIGURE 6.4g PEAK AVERAGE ACCELERATION SPECTRUM

Event :BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'AFT SWAY'
Frequency: 500 (Hz)

Test Time : 81:01:31:13:02
Calibration: 1.2270 (g'/v)

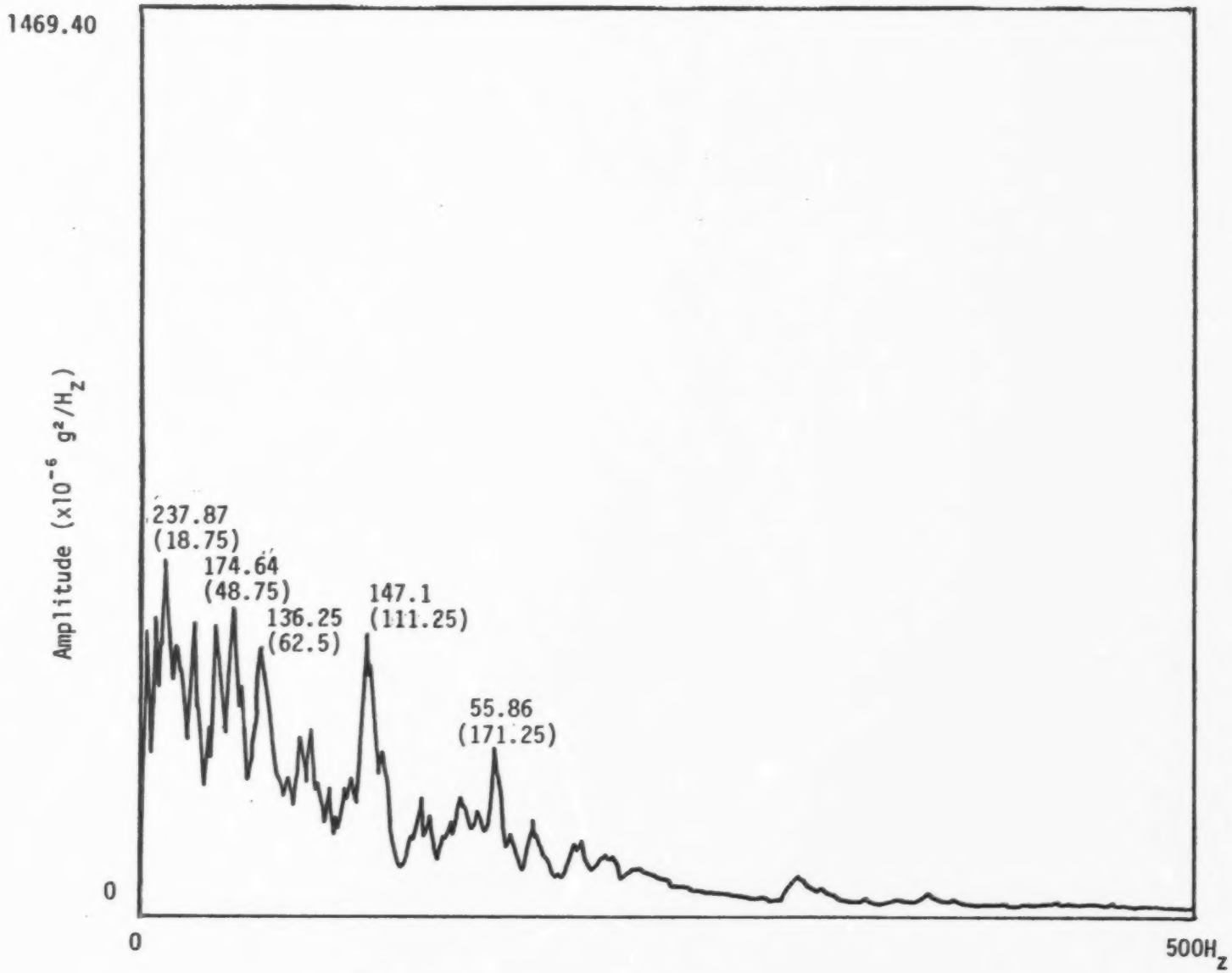


FIGURE 6.4h PEAK AVERAGE ACCELERATION SPECTRUM

Event :BACKING IN LEVEL ICE
Vessel : USCGC POLAR SEA
Sensor : 'AFT HEAVE'
Frequency: 500 (Hz)

Test Time : 81:01:31:13:02
Calibration: 1.2345 (g'/v)

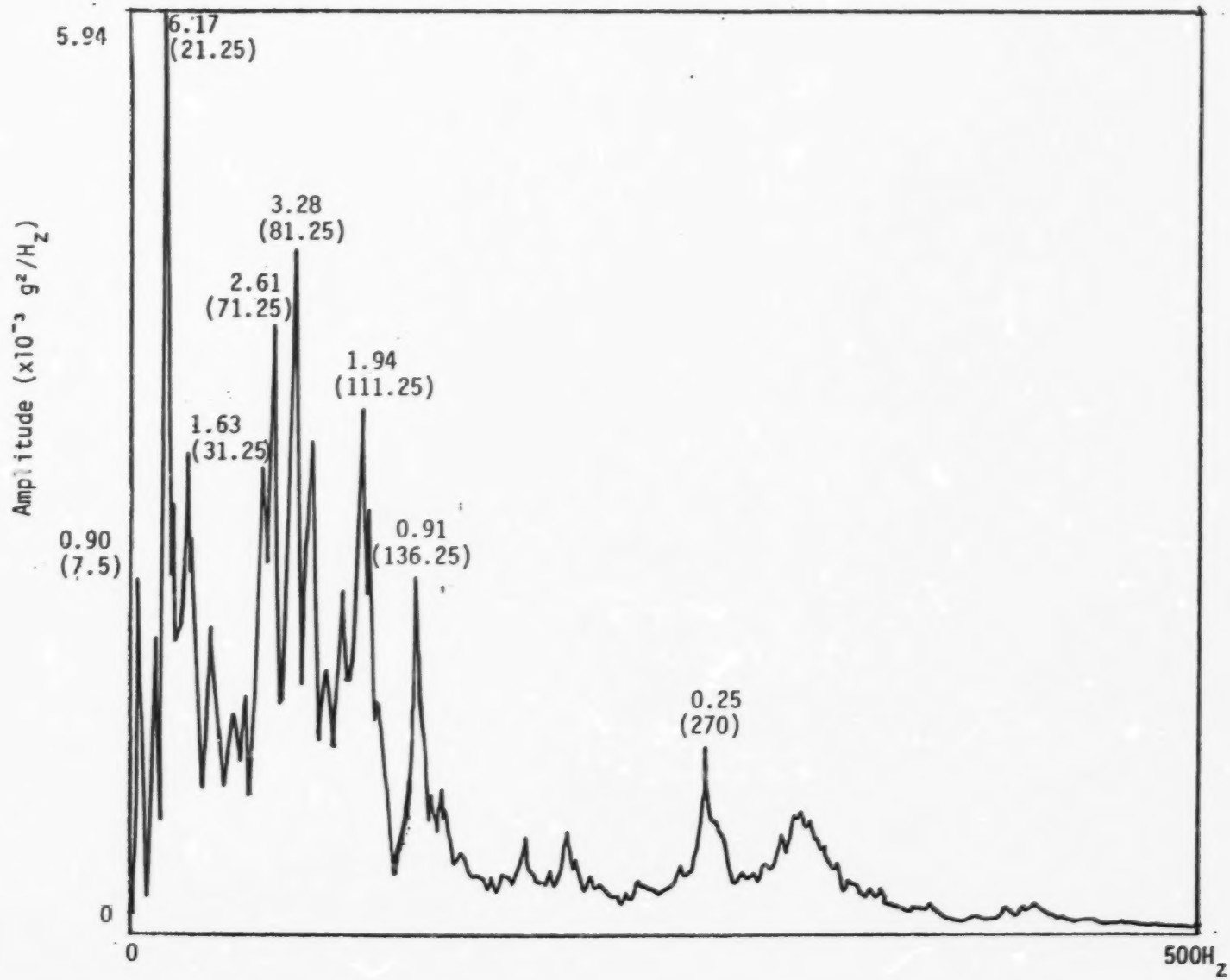


FIGURE 6.5a PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts
Vessel : USCGC POLAR SEA
Sensor : 'BOW SWAY'
Frequency: 50 (Hz)
Test Time : 81:01:30:23:43
Calibration: 1.1940 (g'/v)

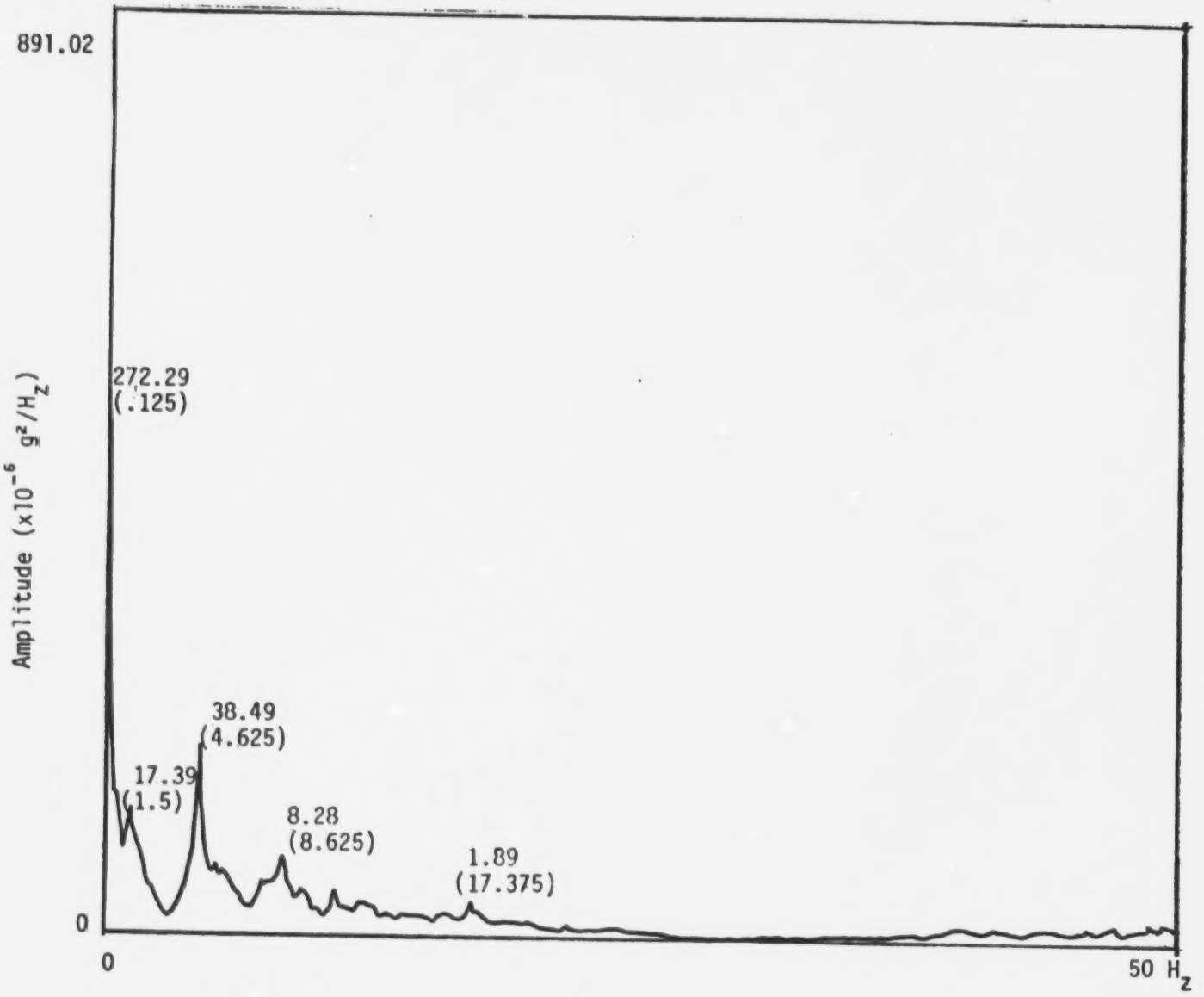


FIGURE 6.5b PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts
Vessel : USCGC POLAR SEA
Sensor : 'BOW HEAVE'
Frequency: 50 (Hz)
Test Time : 81:01:30:23:43
Calibration: 1.2500 (g'/v)

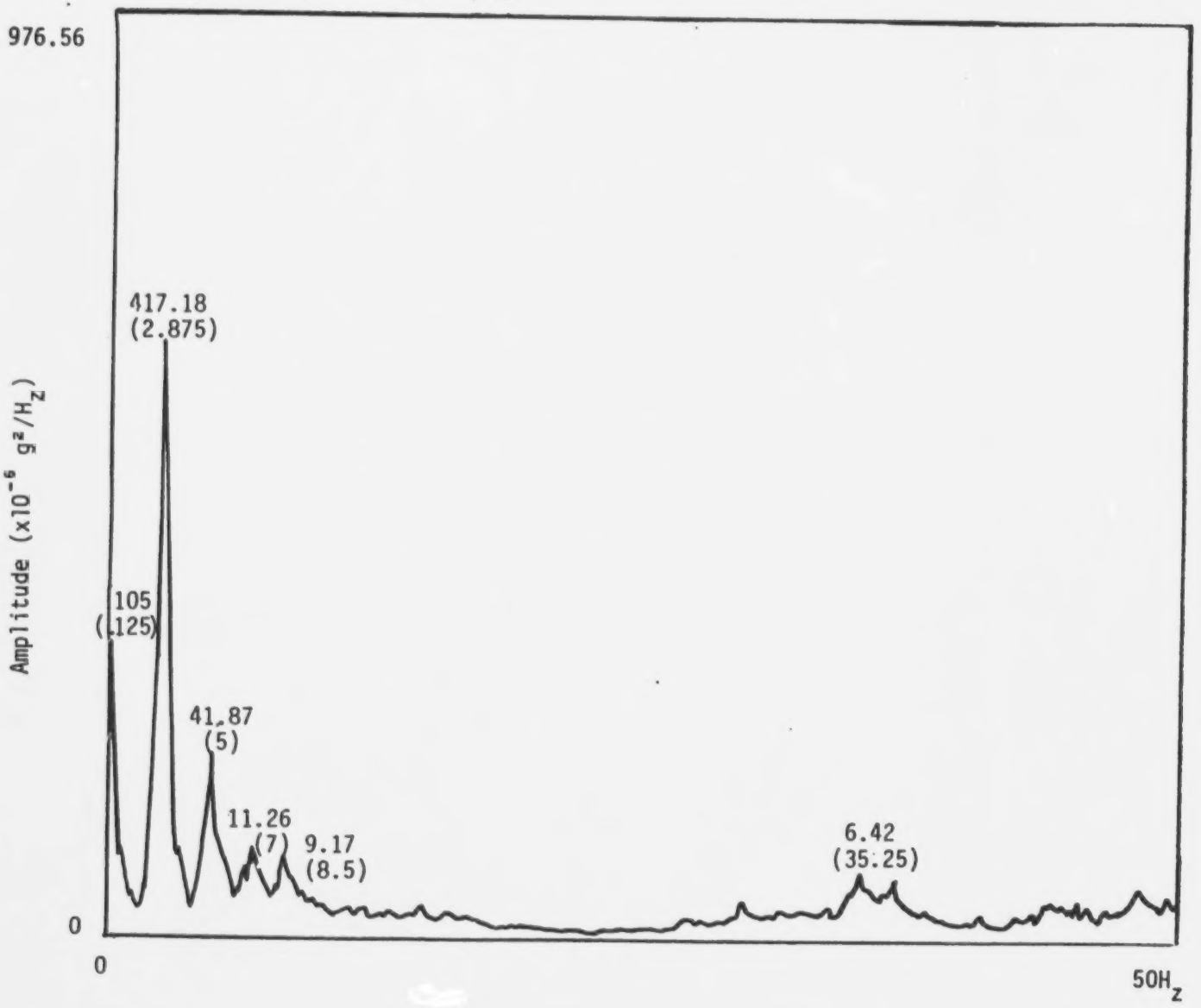


FIGURE 6.5c PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts
Vessel : USCGC POLAR SEA
Sensor : 'SURGE'
Frequency: 50 (Hz)
Test Time : 81:01:30:23:43
Calibration: .9591 (g'/v)

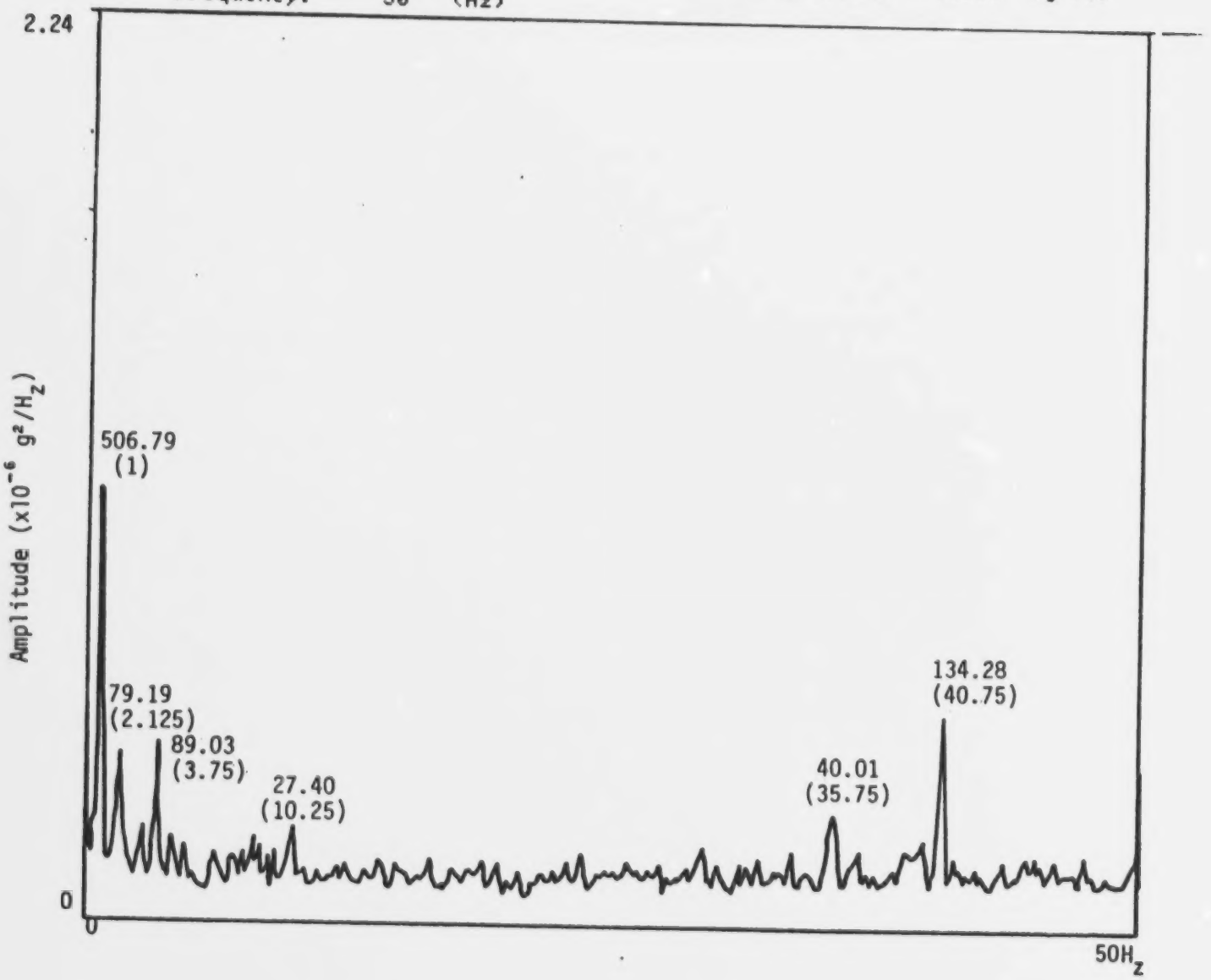


FIGURE 6.5d PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts
Vessel : USCGC POLAR SEA
Sensor : 'SWAY'
Frequency: 50 (Hz)
Test Time : 81:01:30:23:43
Calibration: .9547 (g'/v)

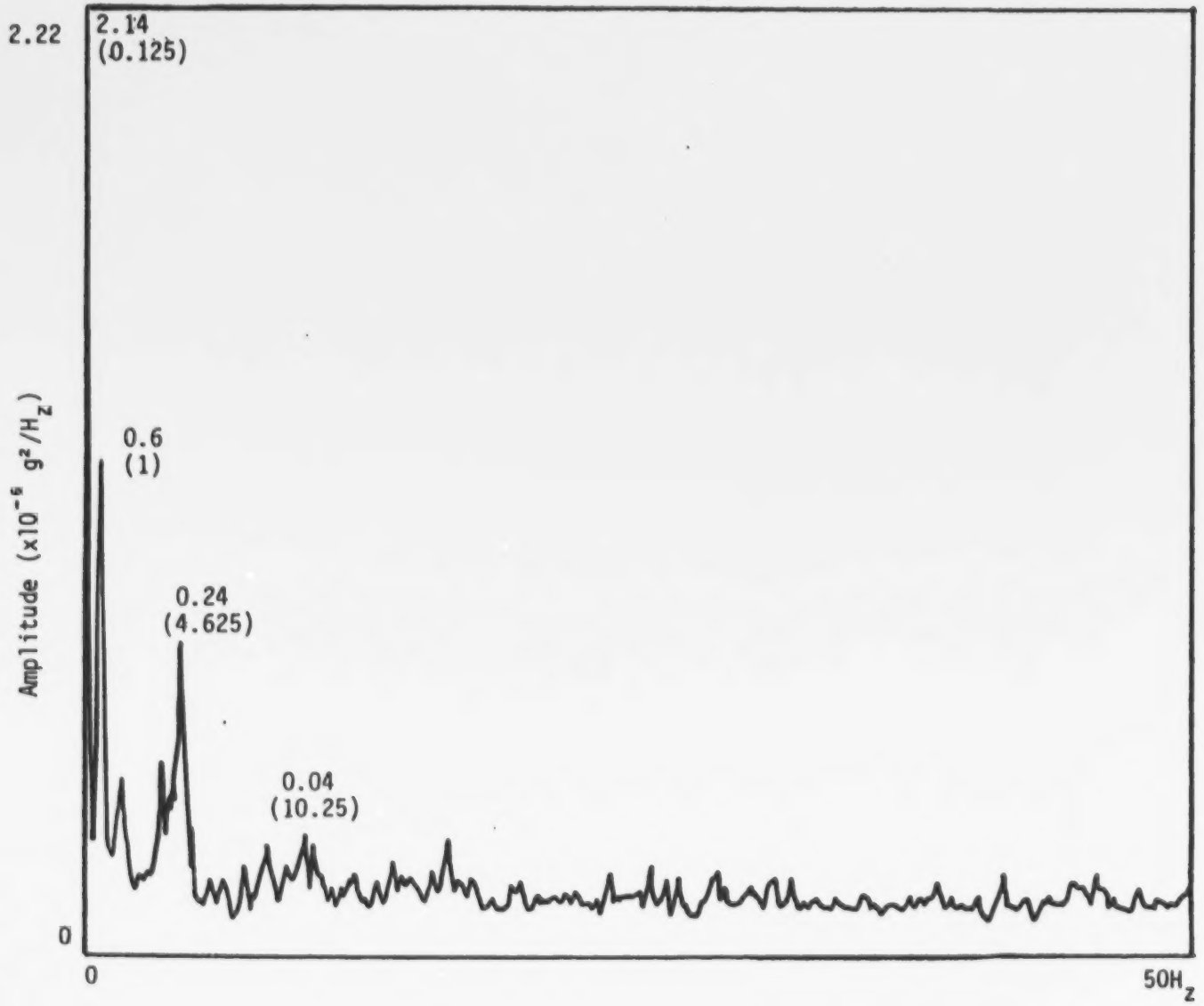


FIGURE 6.5e PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts
Vessel : USCGC POLAR SEA
Sensor : 'HEAVE'
Frequency: 50 (Hz)
Test Time : 81:01:30:23:43
Calibration: .9603 (g'/v)

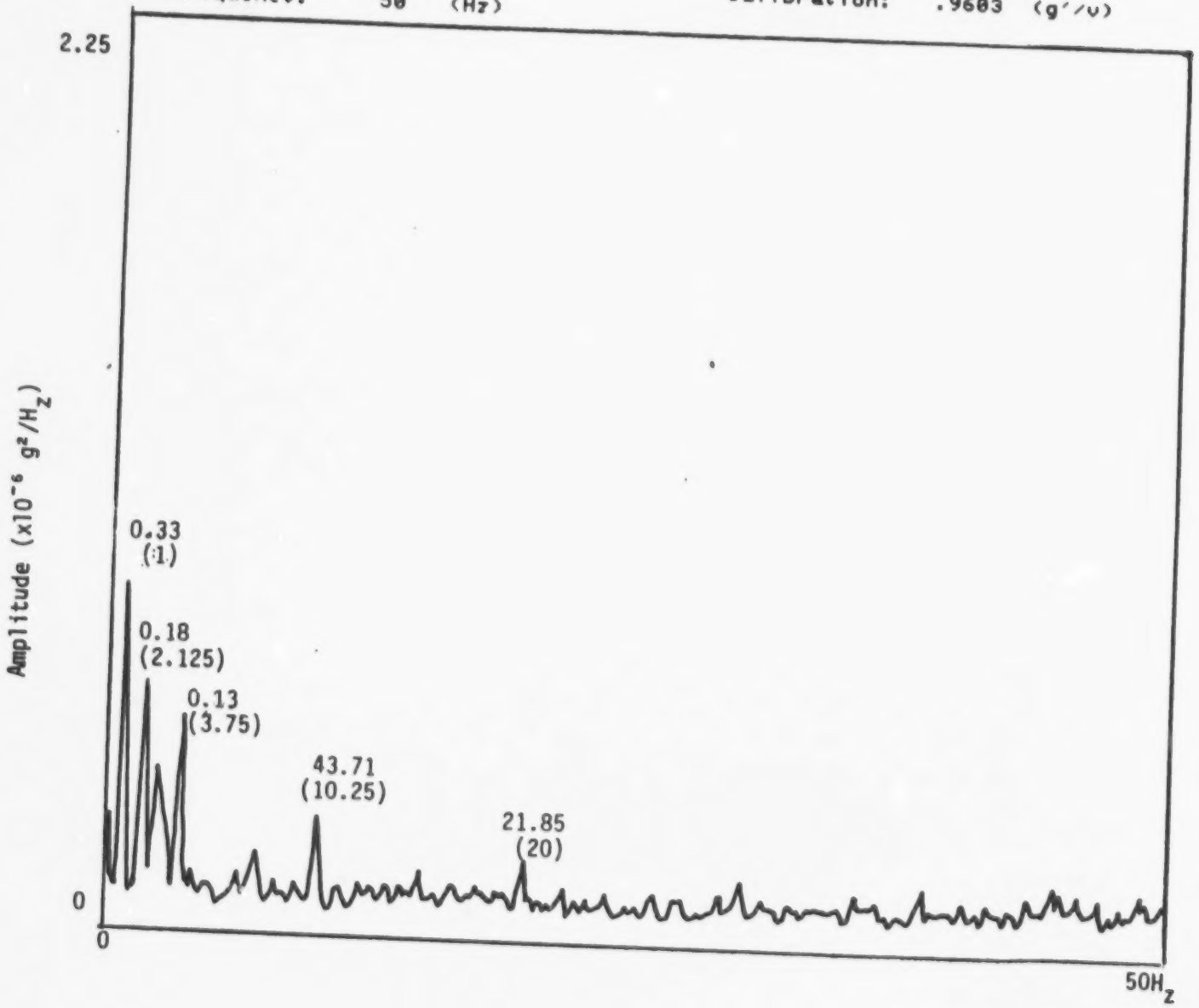


FIGURE 6.5f PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts
Vessel : USCGC POLAR SEA
Sensor : 'AFT SURGE'
Frequency: 50 (Hz)
Test Time : 81:01:30:23:43
Calibration: 1.1834 (g'/v)

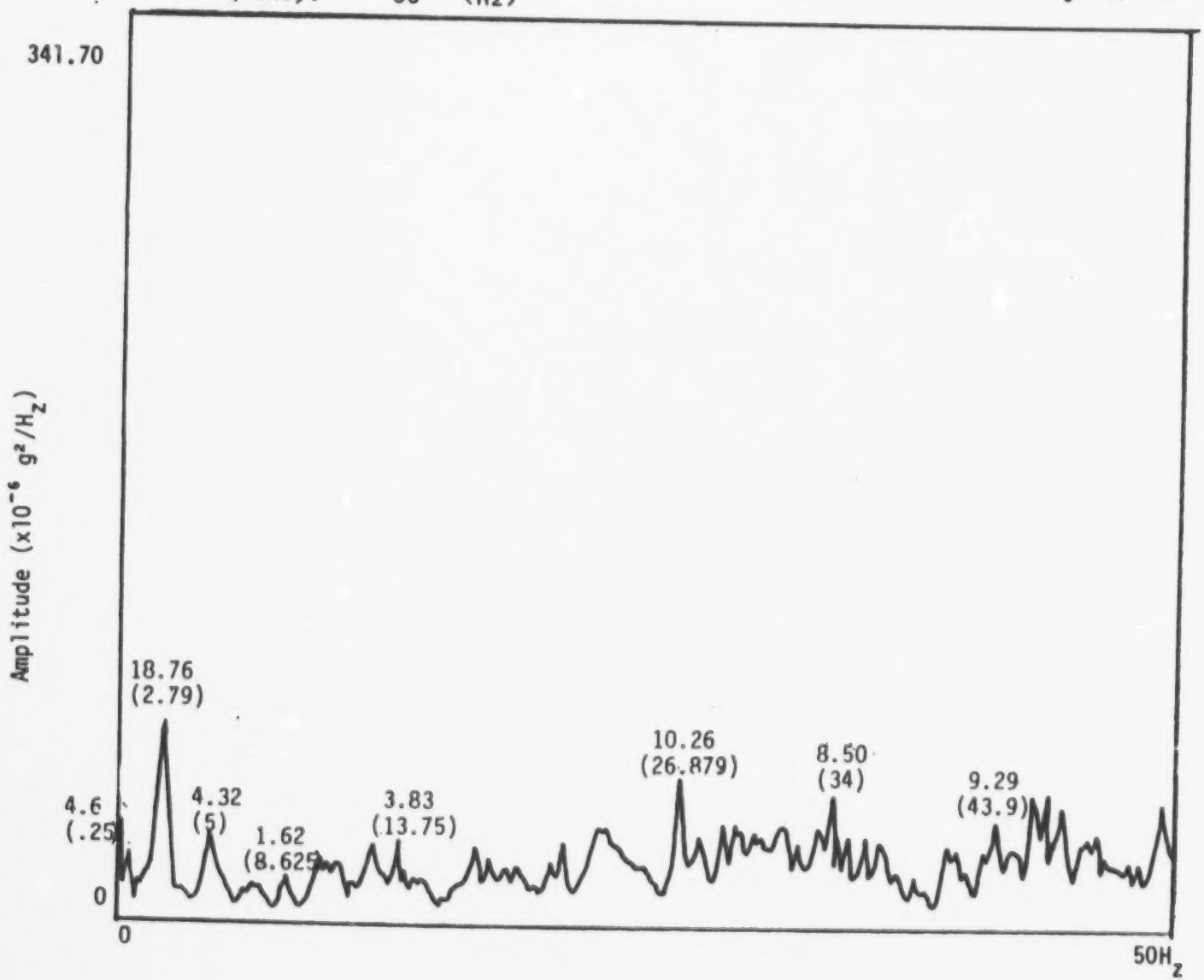


FIGURE 6.5g PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts
Vessel : USCGC POLAR SEA
Sensor : 'AFT SWAY'
Frequency: 50 (Hz)
Test Time : 81:01:30:23:43
Calibration: 1.2270 (g'/v)

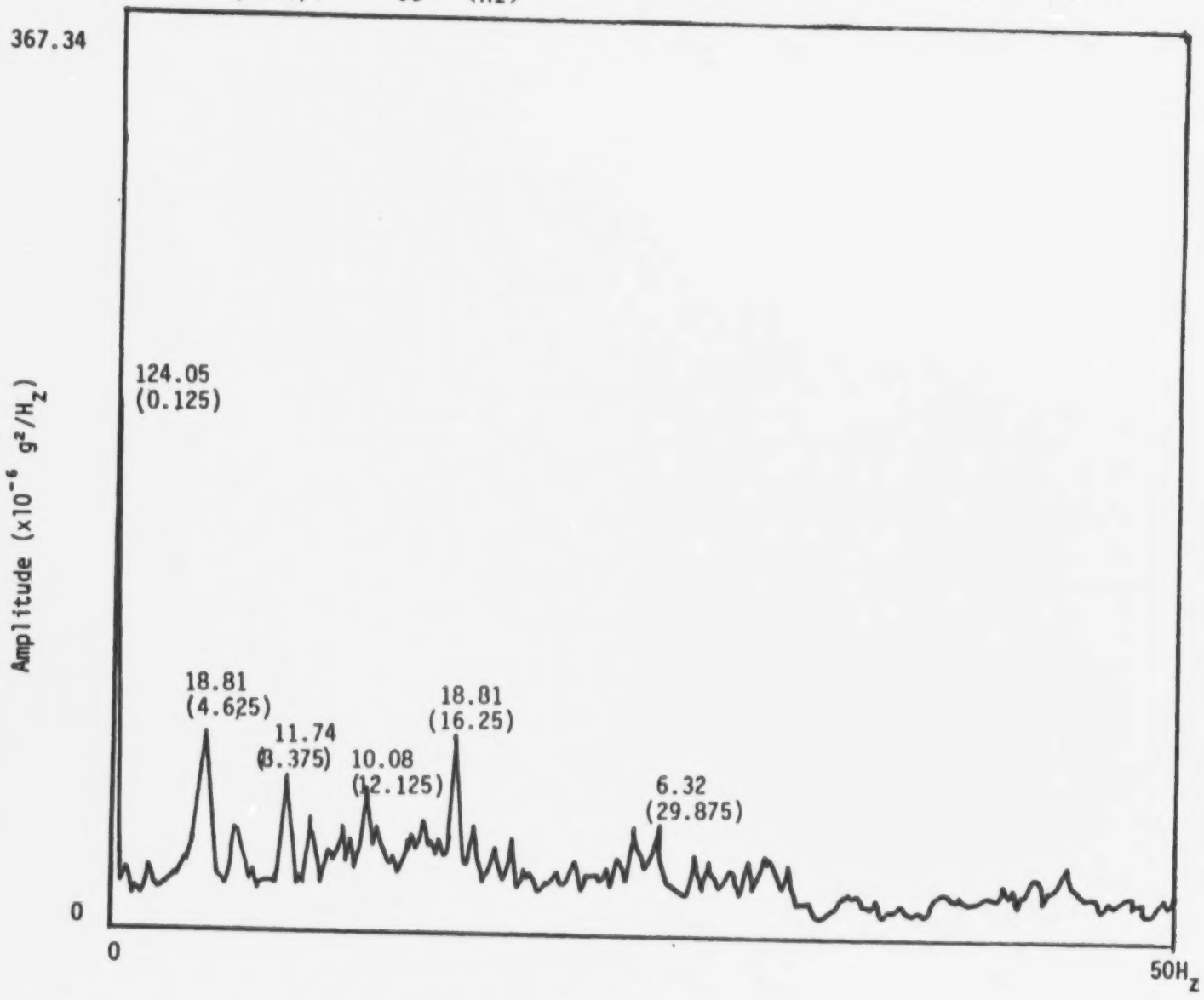


FIGURE 6.5h PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts
Vessel : USCGC POLAR SEA
Sensor : 'AFT HEAVE'
Frequency: 50 (Hz)
Test Time : 81:01:30:23:43
Calibration: 1.2345 (g'/v)

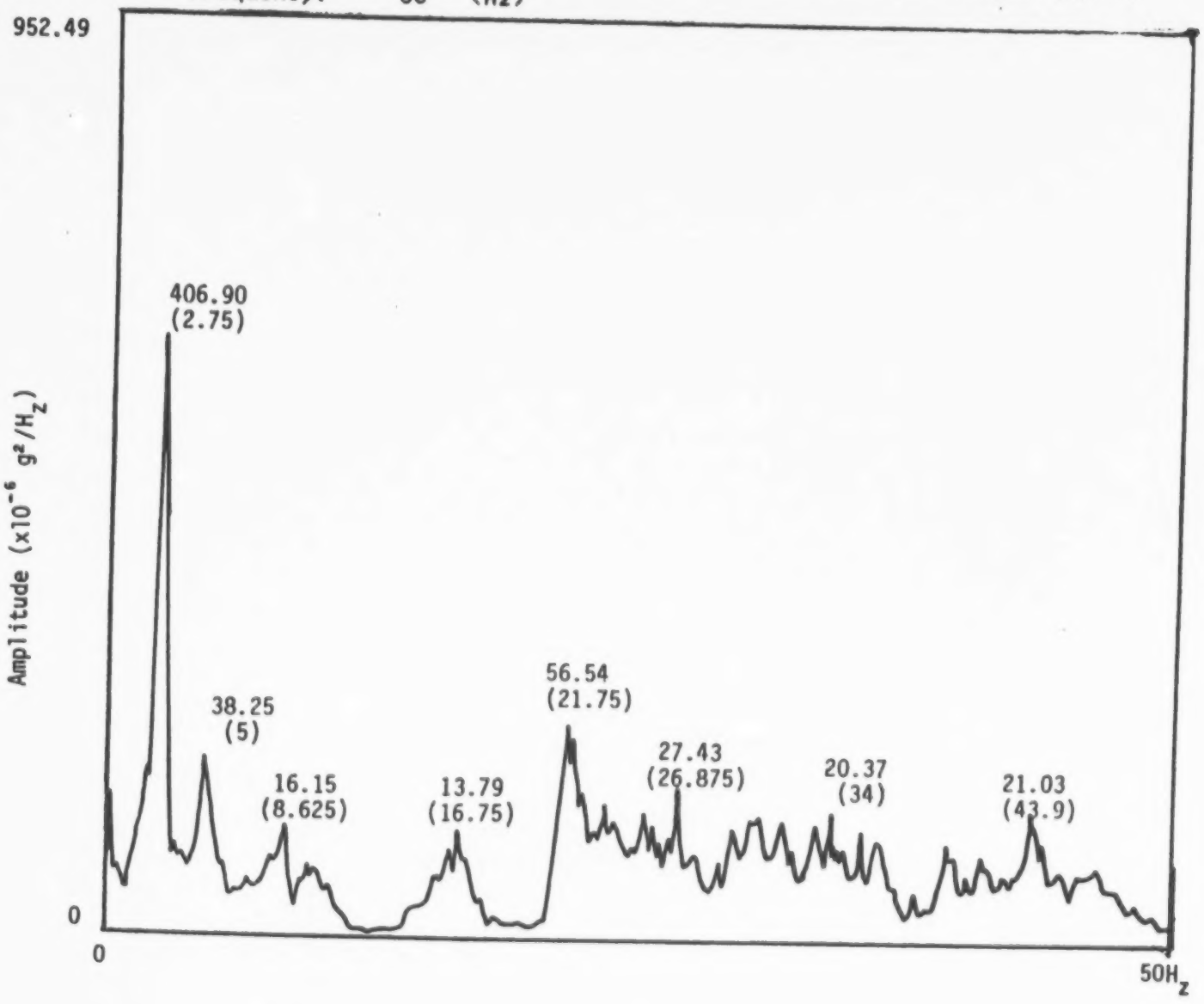


FIGURE 6.6a PEAK AVERAGE ACCELERATION SPECTRUM

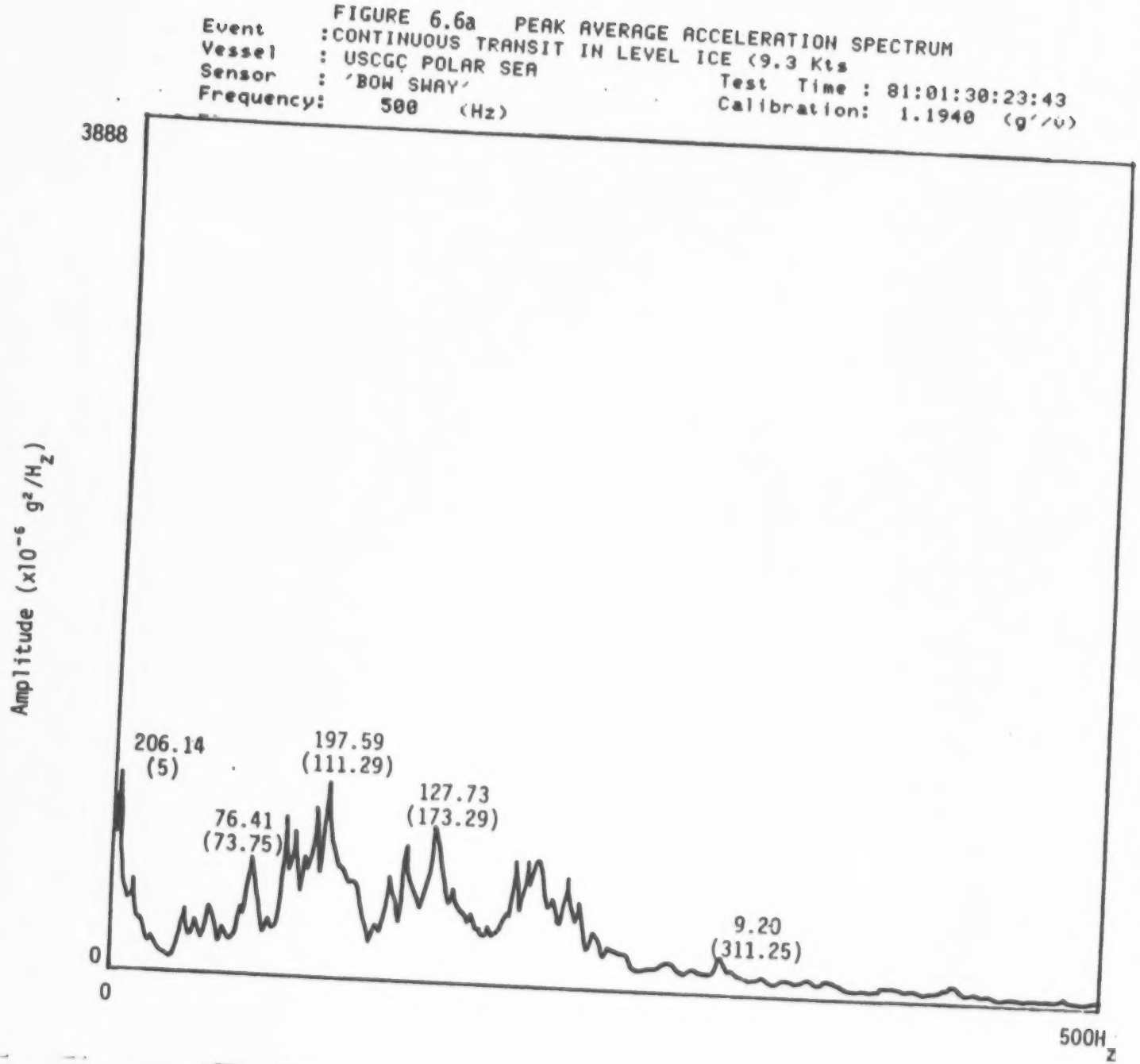


FIGURE 6.6b PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts
Vessel : USCGC POLAR SEA
Sensor : 'BOW HEAVE'
Frequency: 500 (Hz)
Test Time : 81:01:30:23:43
Calibration: 1.2500 (g'/v)

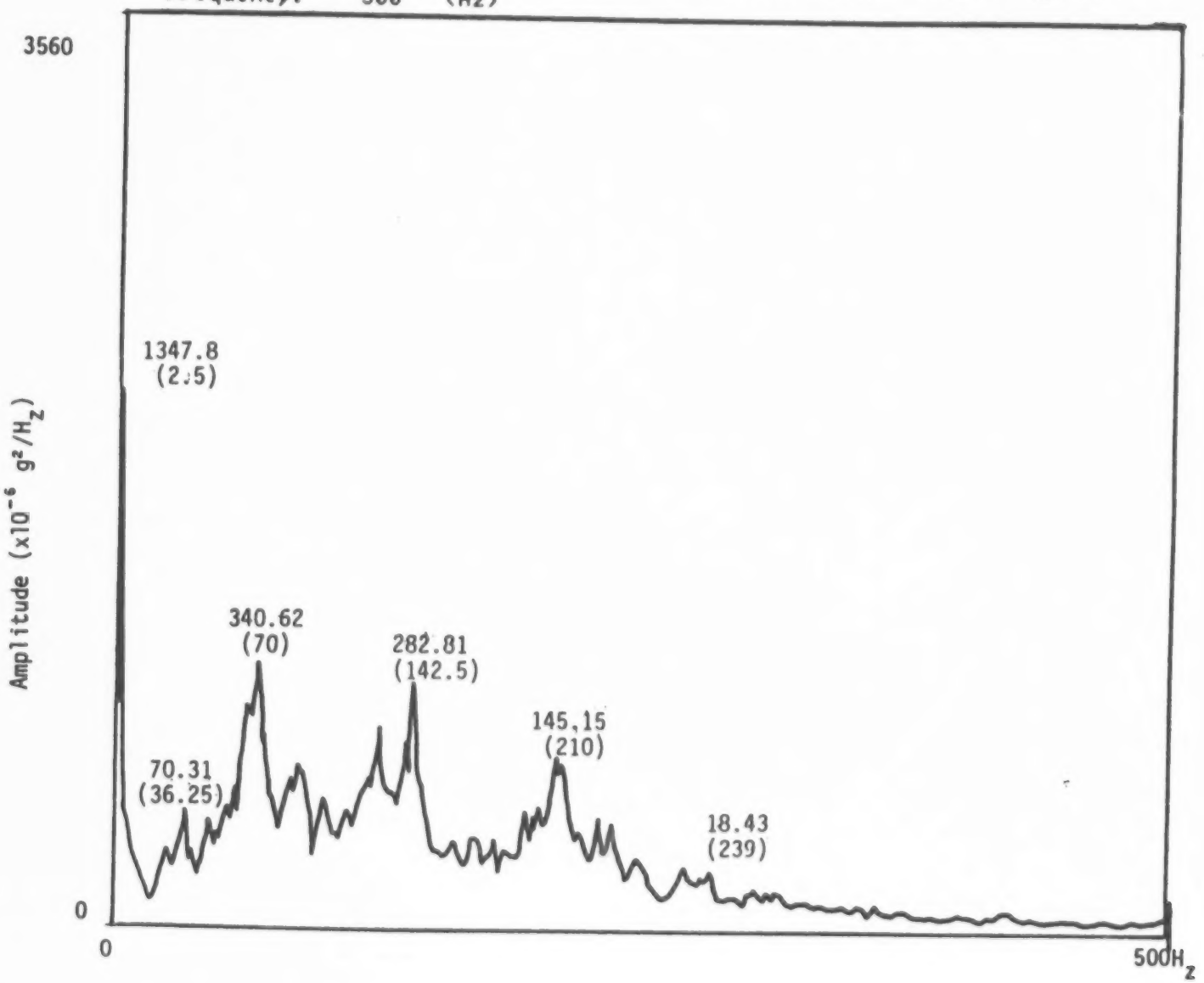


FIGURE 6.6c PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts

Vessel : USCGC POLAR SEA Test Time : 81:01:30:23:43

Sensor : 'SURGE' Calibration: .9591 (g'/v)

Frequency: 500 (Hz)

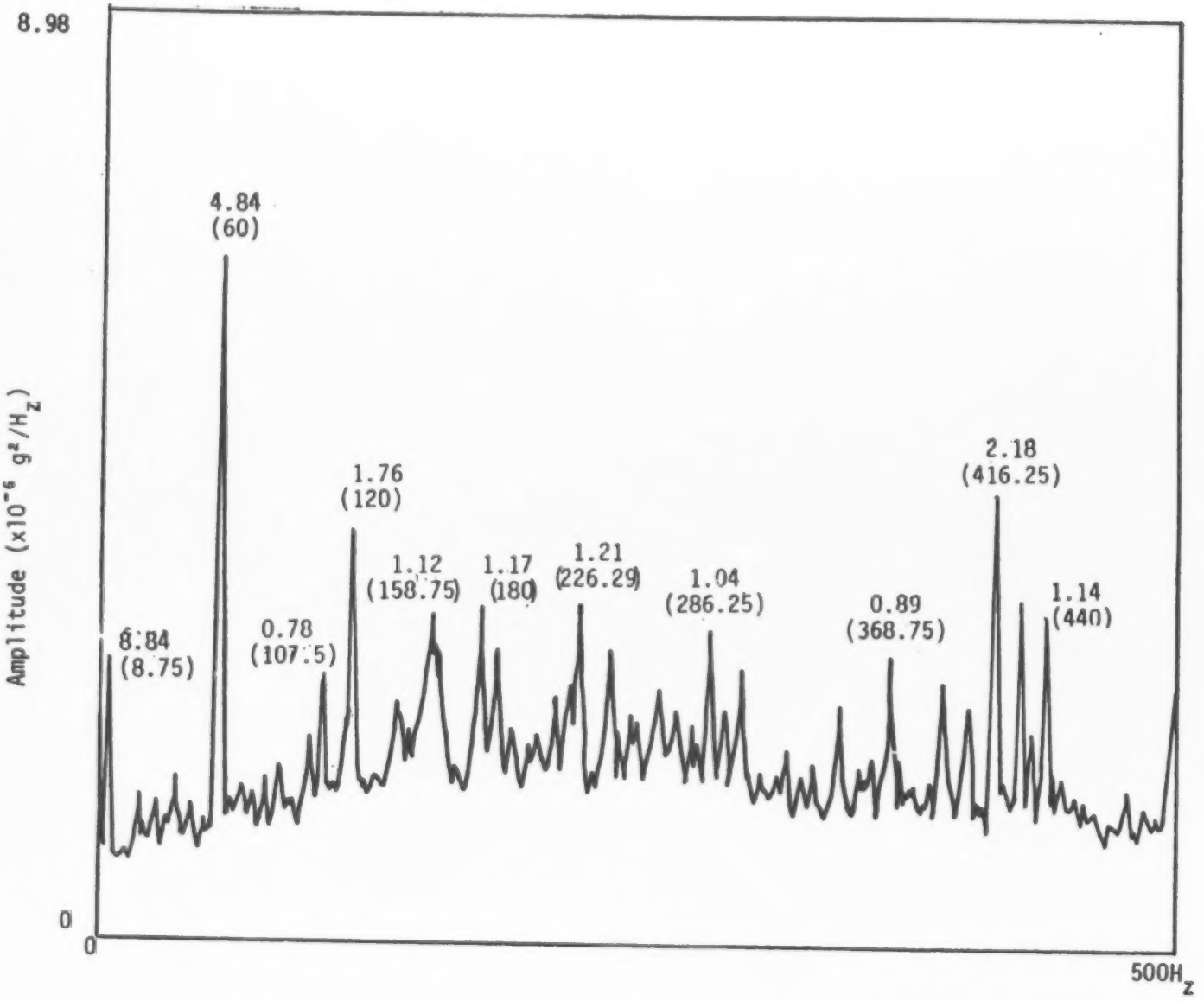


FIGURE 6.6d PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts
Vessel : USCGC POLAR SEA
Sensor : 'SWAY'
Frequency: 500 (Hz)
Test Time : 81:01:30:23:43
Calibration: .9547 (g'/v)

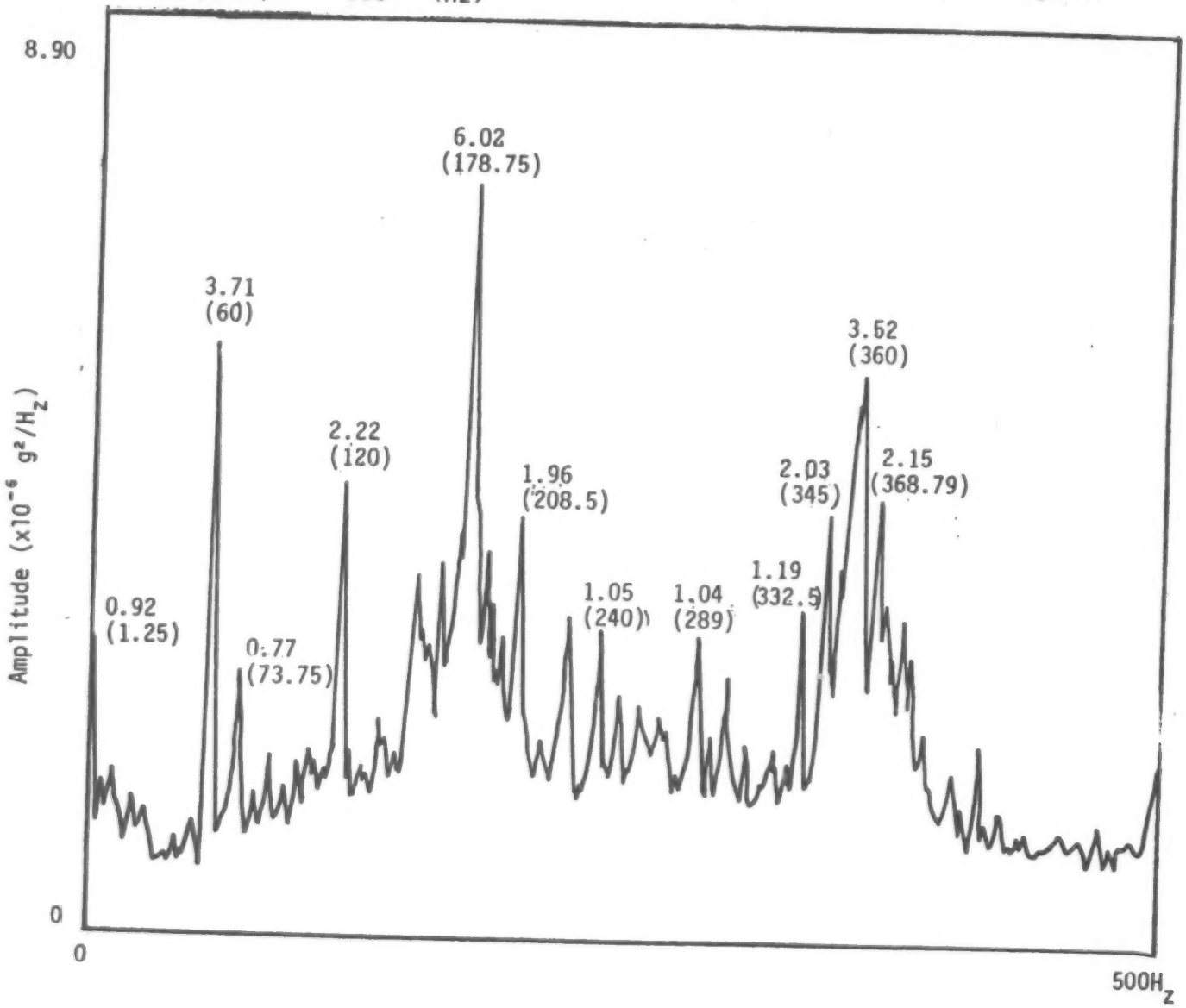


FIGURE 6.6e PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts

Vessel : USCGC POLAR SEA Test Time : 81:01:30:23:43

Sensor : 'HEAVE' Calibration: .9603 (g''/v)

Frequency: 500 (Hz)

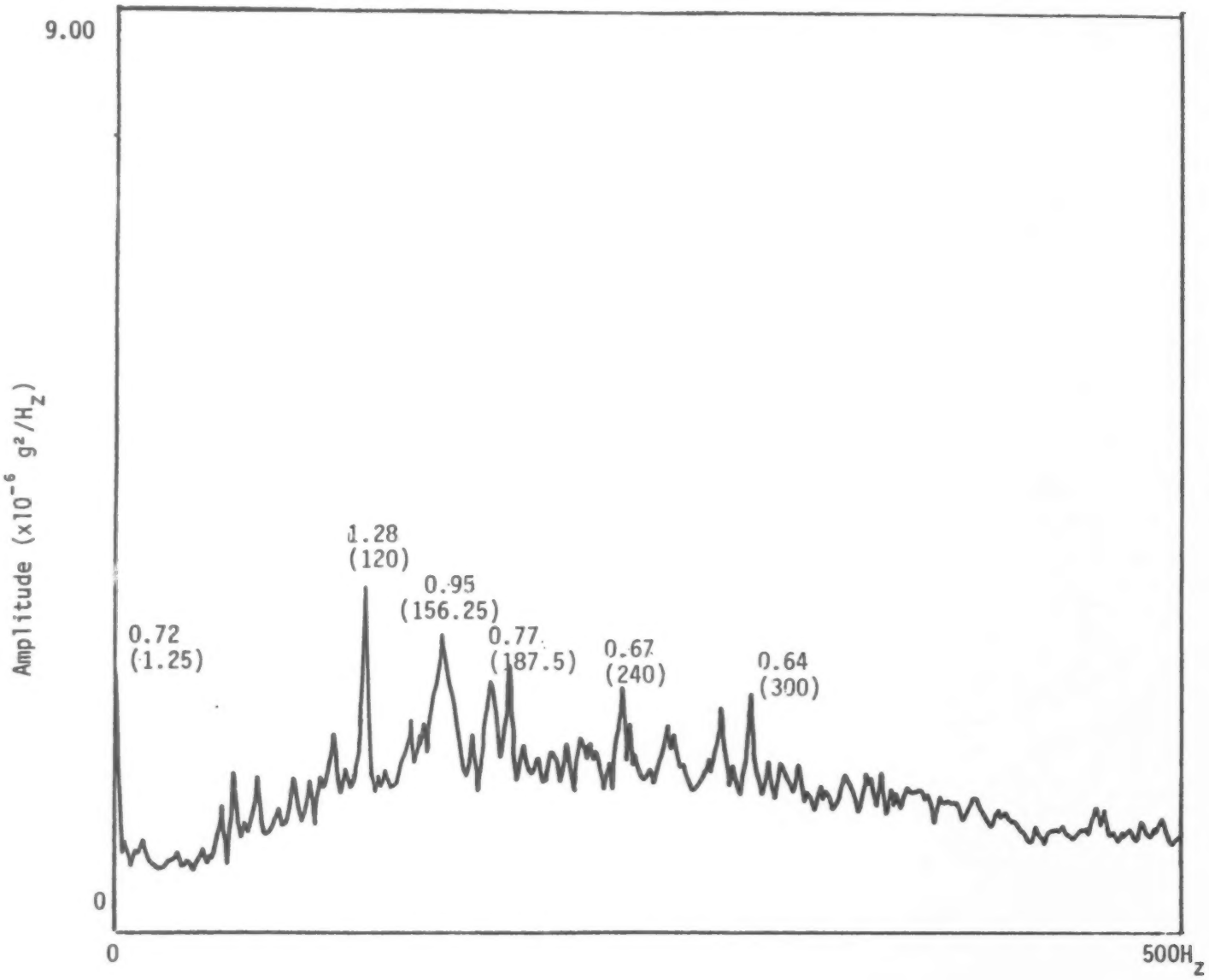


FIGURE 6.6f PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts
Vessel : USCGC POLAR SEA
Sensor : 'AFT SURGE'
Frequency: 500 (Hz)
Test Time : 81:01:30:23:43
Calibration: 1.1834 (g'/v)

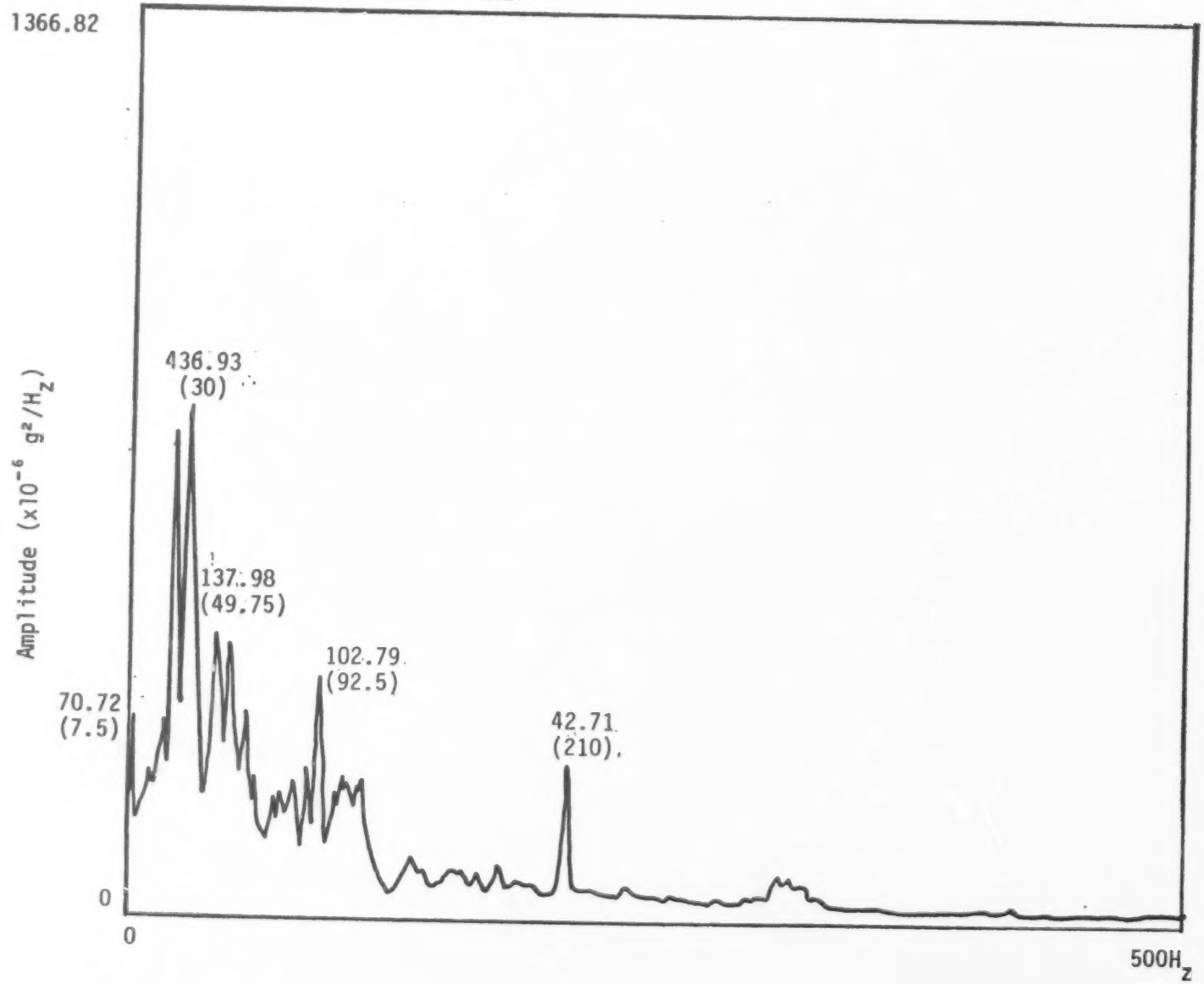


FIGURE 6.6g PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts
Vessel : USCGC POLAR SEA
Sensor : 'AFT SWAY'
Frequency: 500 (Hz)
Test Time : 81:01:30:23:43
Calibration: 1.2270 (g'/v)

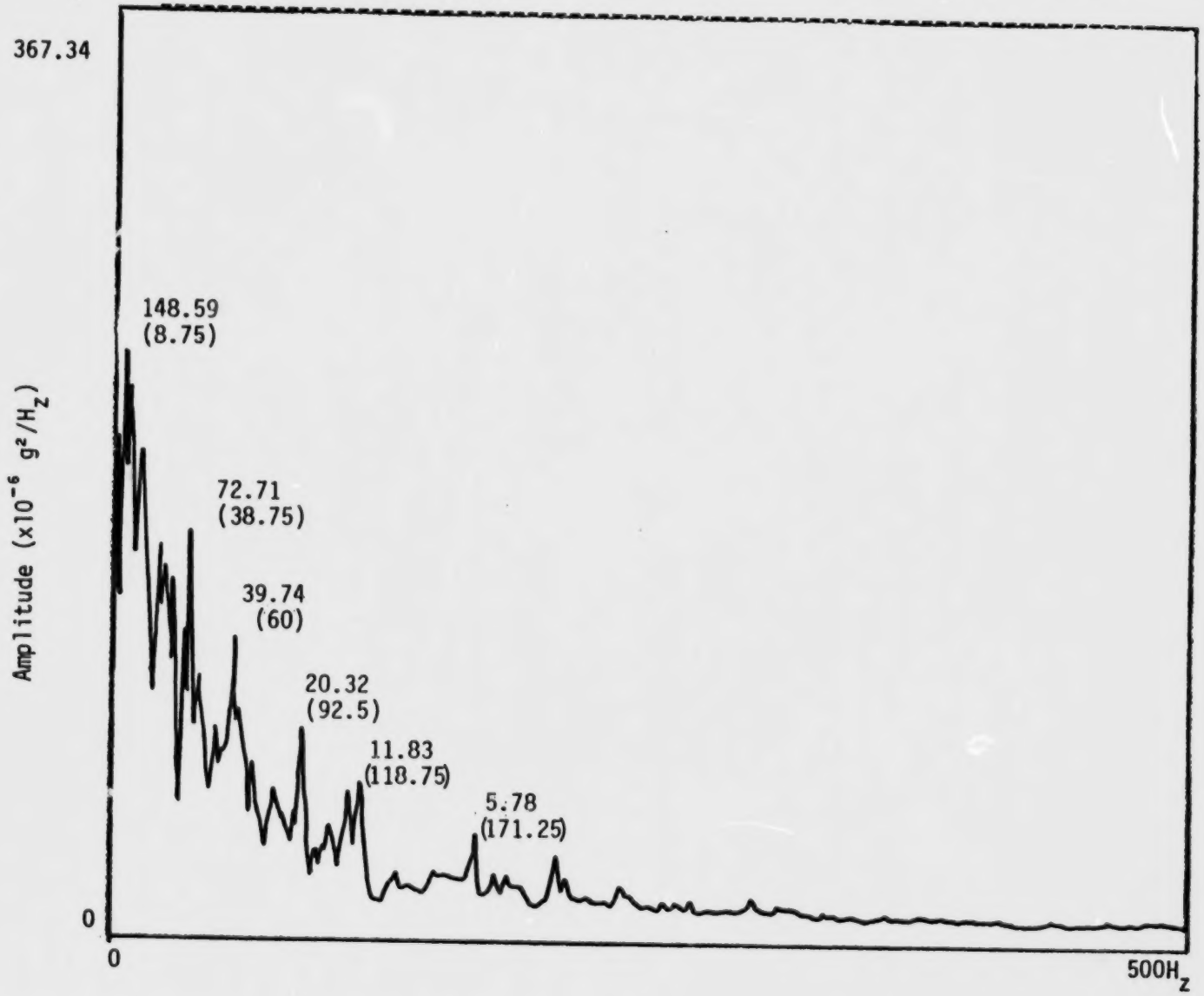


FIGURE 6.6h PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (9.3 Kts

Vessel : USCGC POLAR SEA Test Time : 81:01:30:23:43

Sensor : 'AFT HEAVE' Calibration: 1.2345 (g'/v)

Frequency: 500 (Hz)

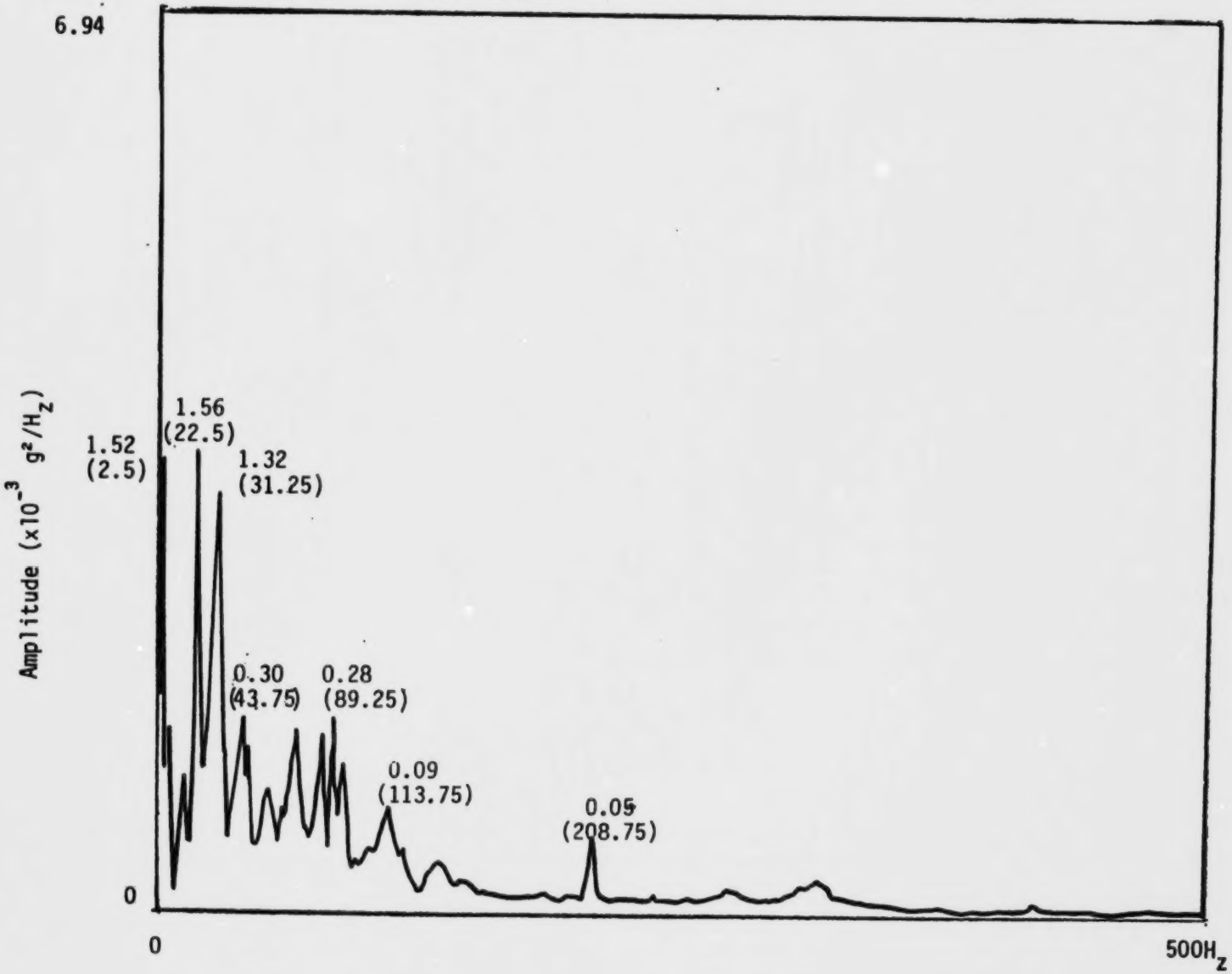


FIGURE 6.7a PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts
Vessel : USCGC POLAR SEA Test Time : 81:01:31:14:10
Sensor : 'BOW SWAY' Calibration: 1.1940 (g'/v)
Frequency: 50 (Hz)

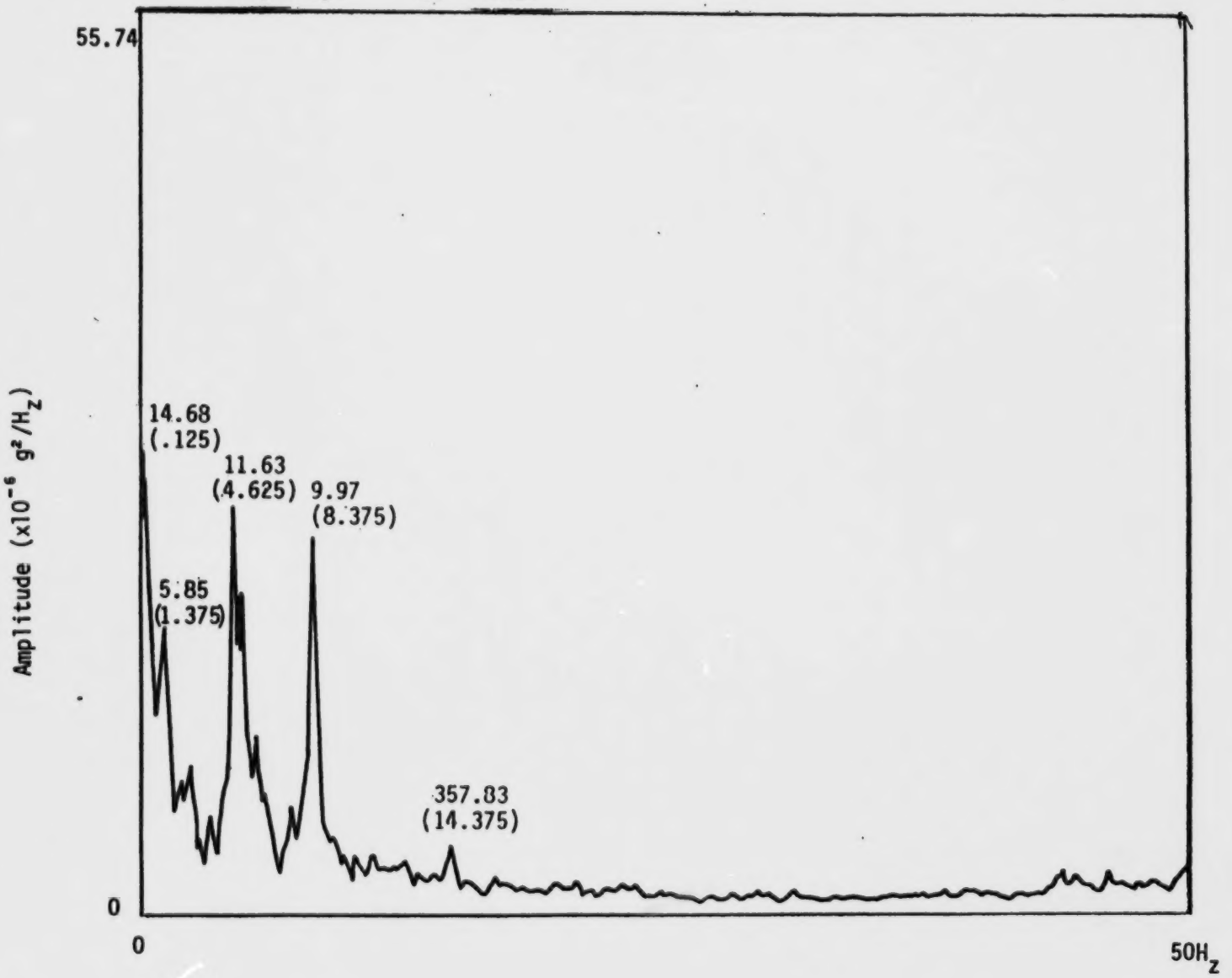


FIGURE 6.7b PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts
Vessel : USCGC POLAR SEA
Sensor : 'BOW HEAVE'
Frequency: 50 (Hz)
Test Time : 81:01:31:14:10
Calibration: 1.2500 (g'/v)

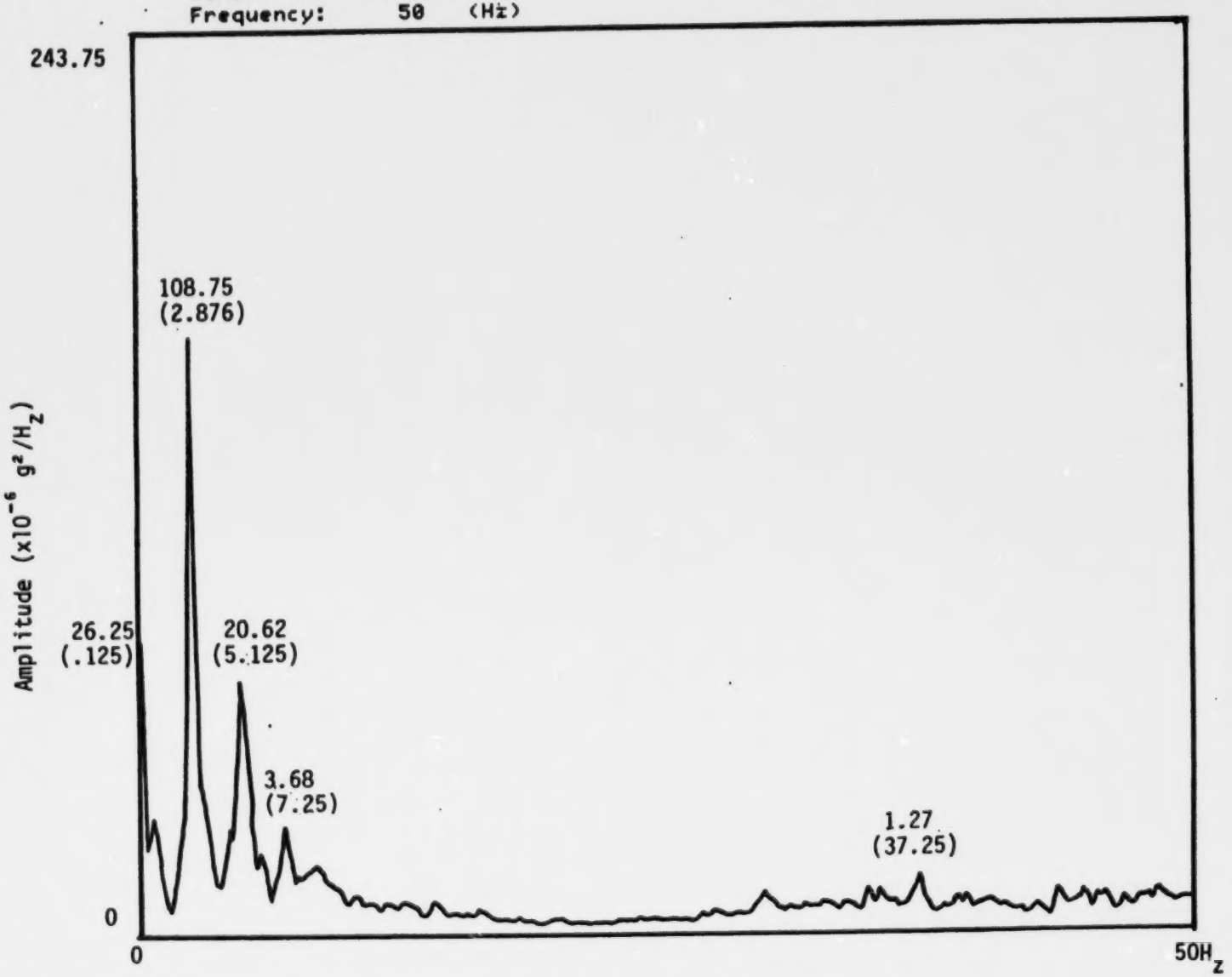


FIGURE 6.7c PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE < 6 Kts
Vessel : USCGC POLAR SEA
Sensor : 'SURGE'
Frequency: 50 (Hz)
Test Time : 81:01:31:14:10
Calibration: .9591 (g'/v)

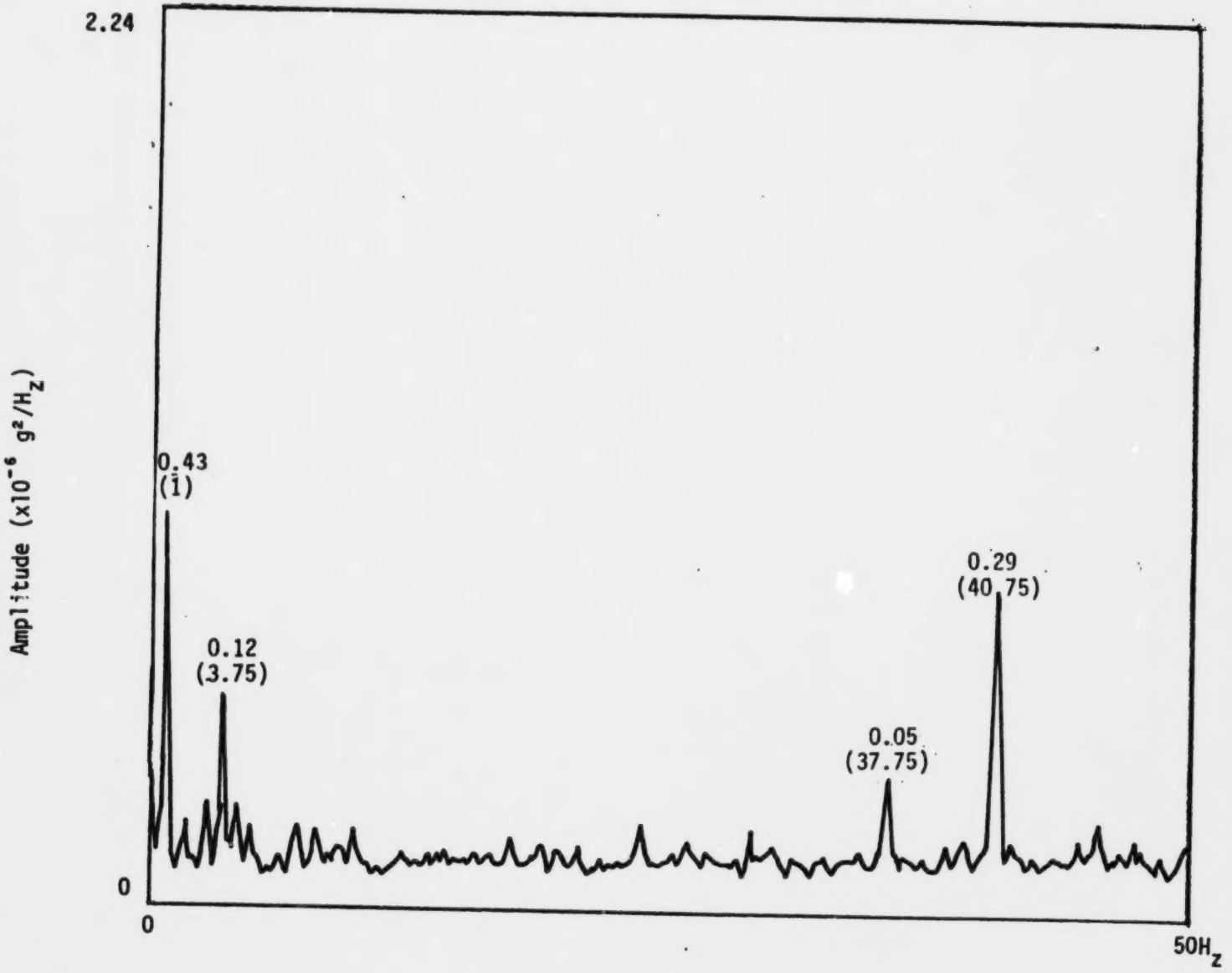


FIGURE 6.7d PEAK AVERAGE ACCELERATION SPECTRUM

Event : CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts
Vessel : USCGC POLAR SEA
Sensor : 'SWAY'
Frequency: 50 (Hz)
Test Time : 81:01:31:14:10
Calibration: .9547 (g^2/v)

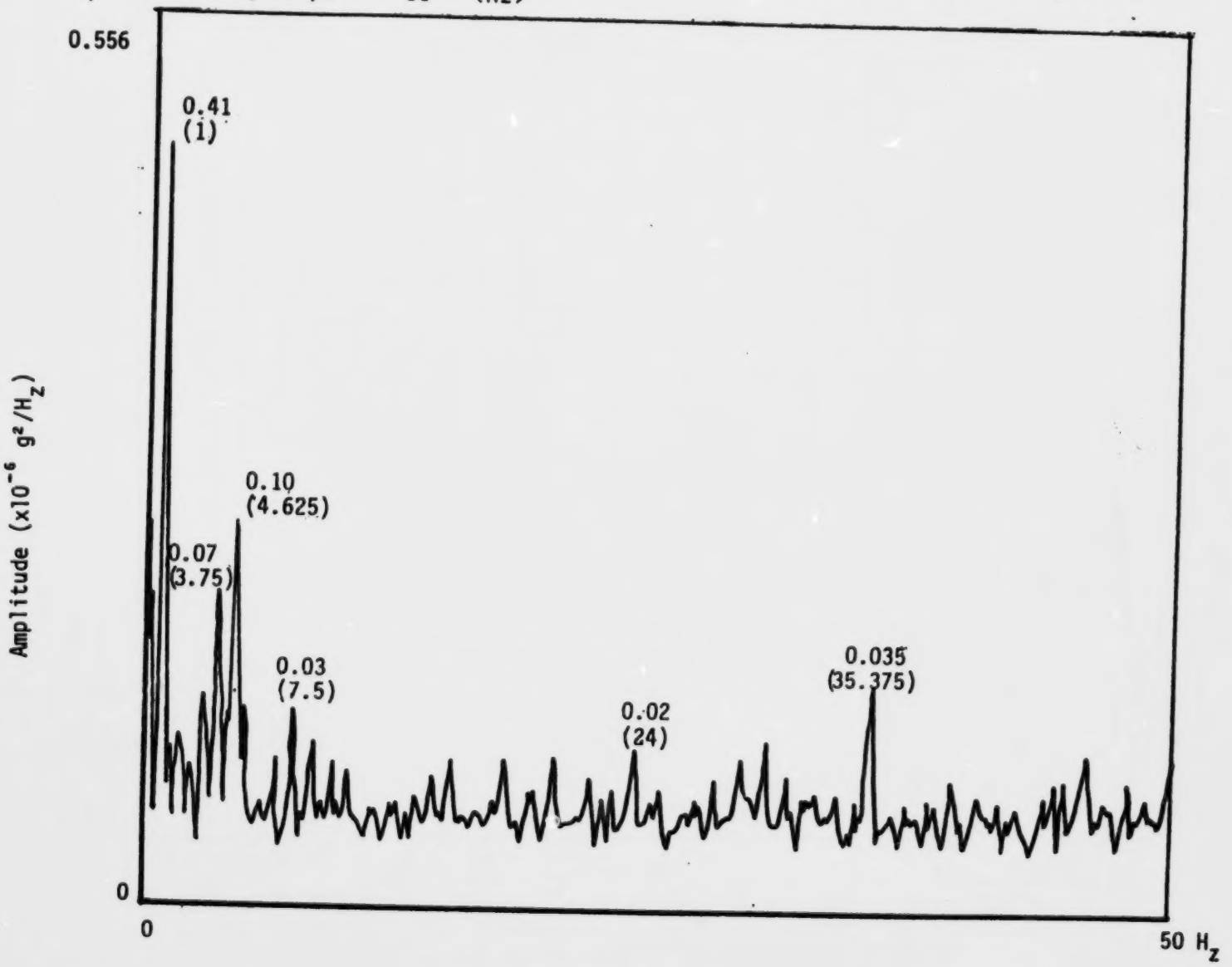


FIGURE 6.7e PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts
Vessel : USCGC POLAR SEA Test Time : 81:01:31:14:10
Sensor : 'HEAVE' Calibration: .9603 (g'/v)
Frequency: 50 (Hz)

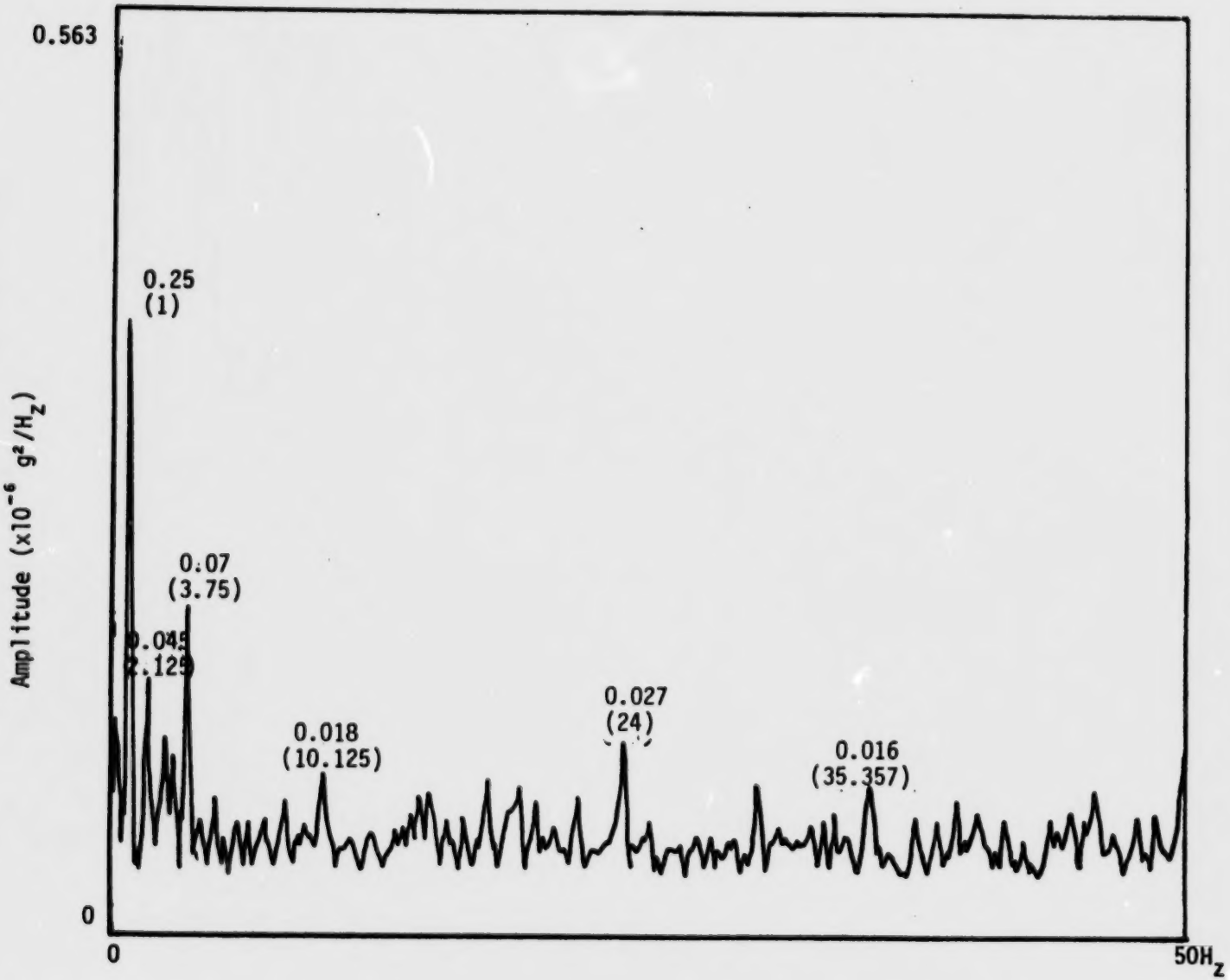


FIGURE 6.7f PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts
Vessel : USCGC POLAR SEA
Sensor : 'AFT SURGE'
Frequency: 50 (Hz)
Test Time : 81:01:31:14:10
Calibration: 1.1834 (g'/v)

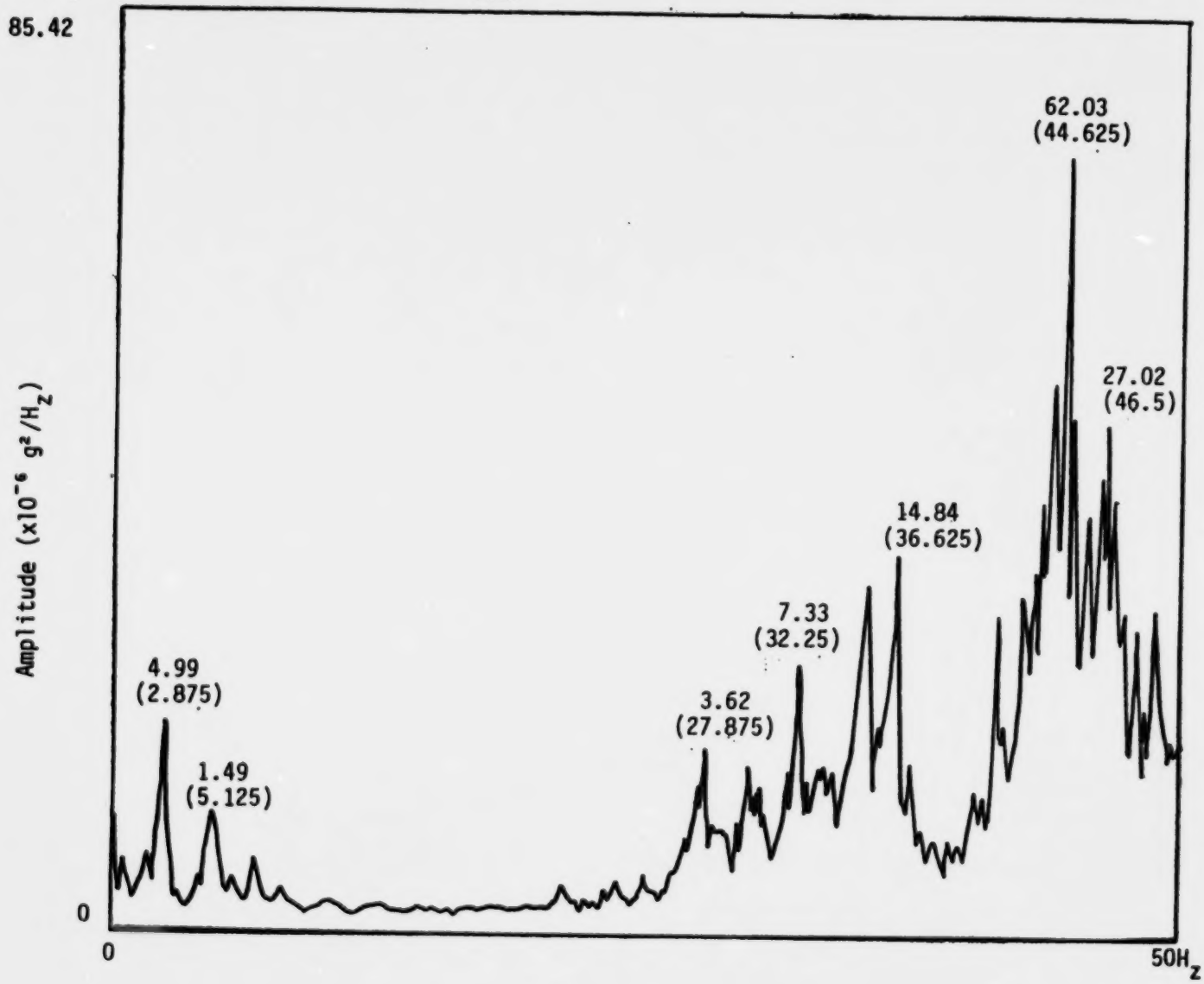


FIGURE 6.7g PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts
Vessel : USCGC POLAR SEA Test Time : 81:01:31:14:10
Sensor : 'AFT SWAY' Calibration: 1.2270 (g'/v)
Frequency: 50 (Hz)

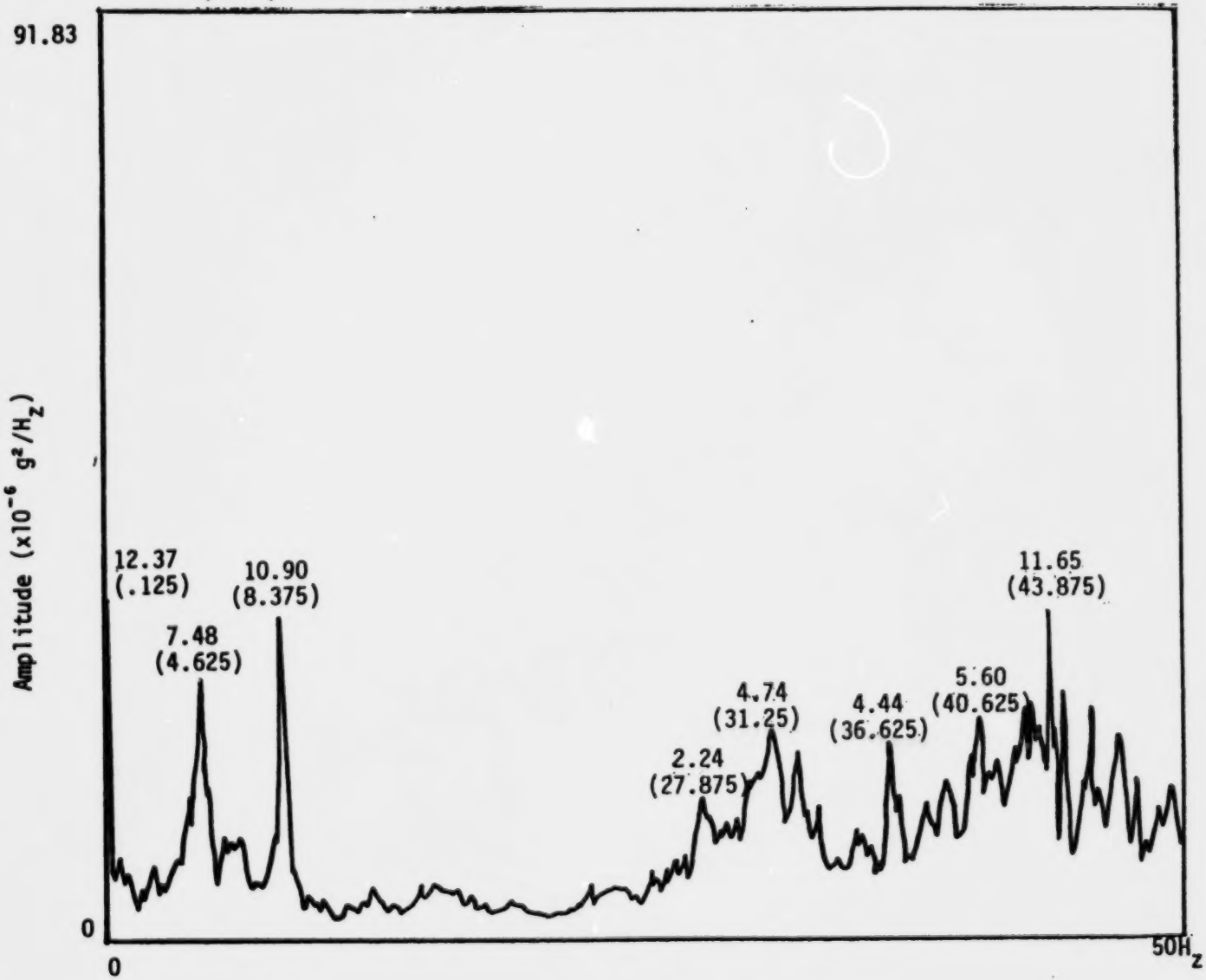


FIGURE 6.7h PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts
Vessel : USCGC POLAR SEA
Sensor : 'AFT HEAVE'
Frequency: 50 (Hz)
Test Time : 81:01:31:14:10
Calibration: 1.2345 (g'/v)

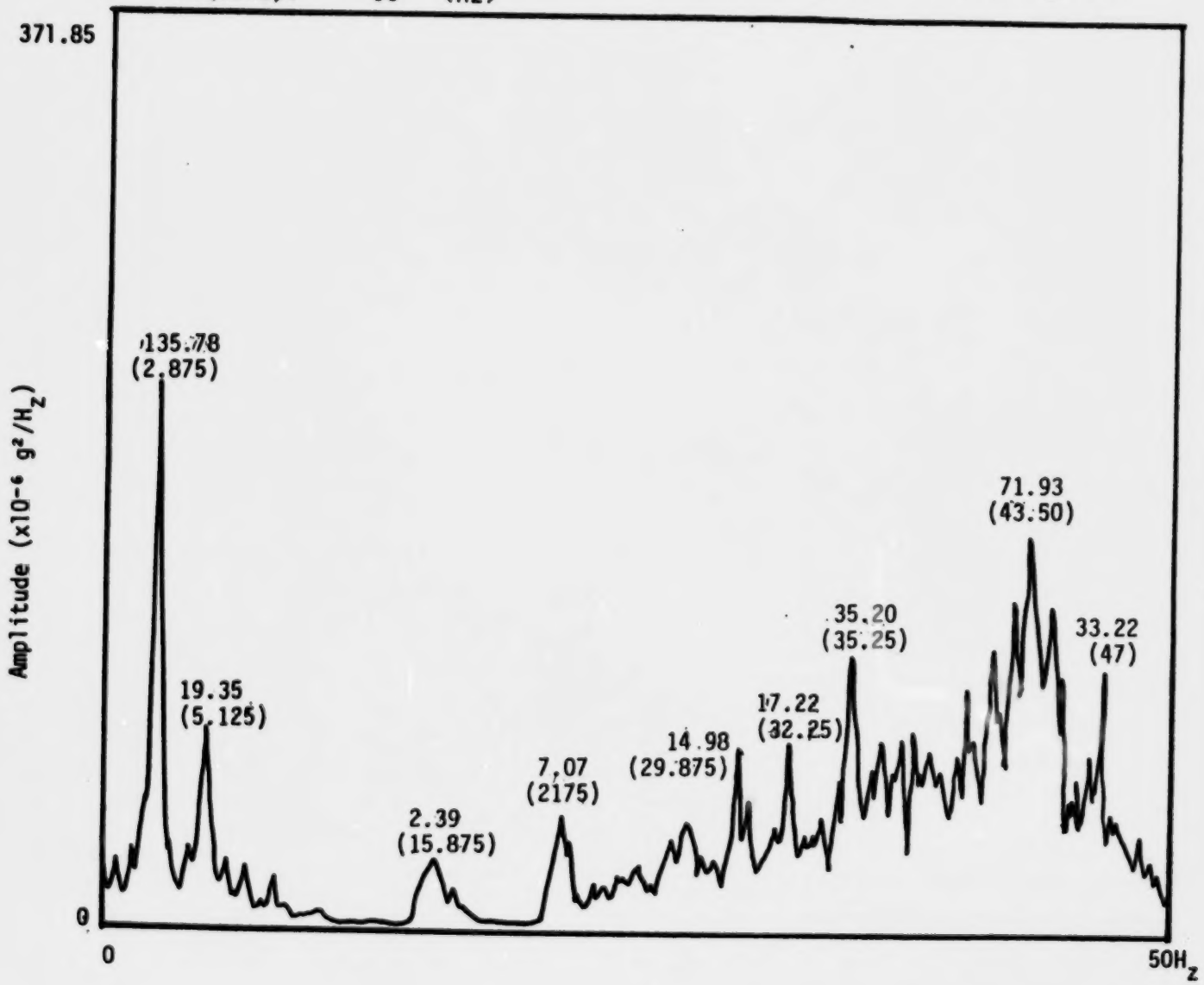


FIGURE 6.8a PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts 1.5' Thk)
Vessel : USCGC POLAR SEA Test Time : 81:01:31:14:10
Sensor : 'BOW SWAY' Calibration: 1.1940 (g'/v)
Frequency: 500 (Hz)

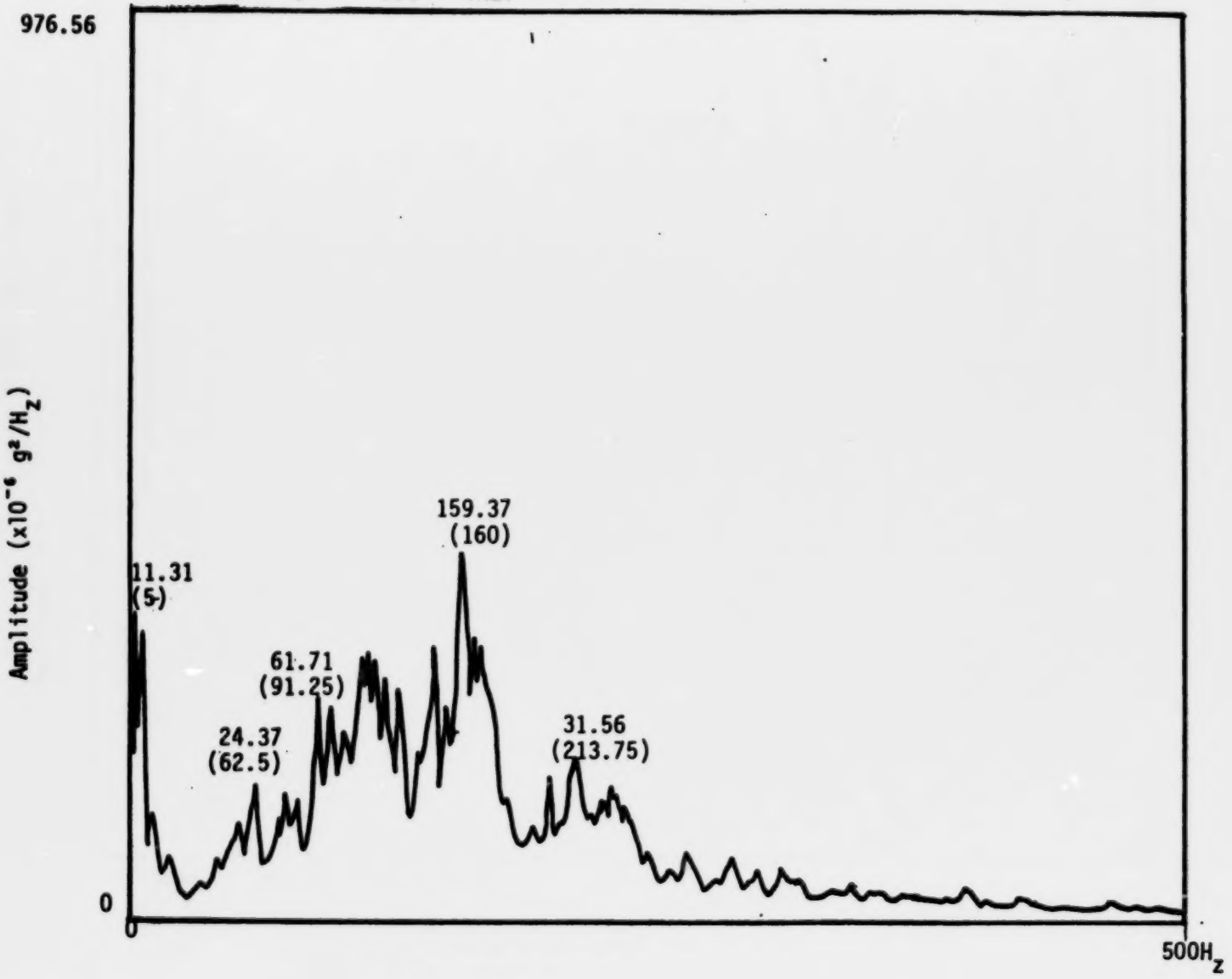


FIGURE 6.8b PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts 1.5′ Thk)
Vessel : USCGC POLAR SEA Test Time : 81:01:31:14:10
Sensor : 'BOW HEAVE' Calibration: 1.2500 (g'/v)
Frequency: 500 (Hz)

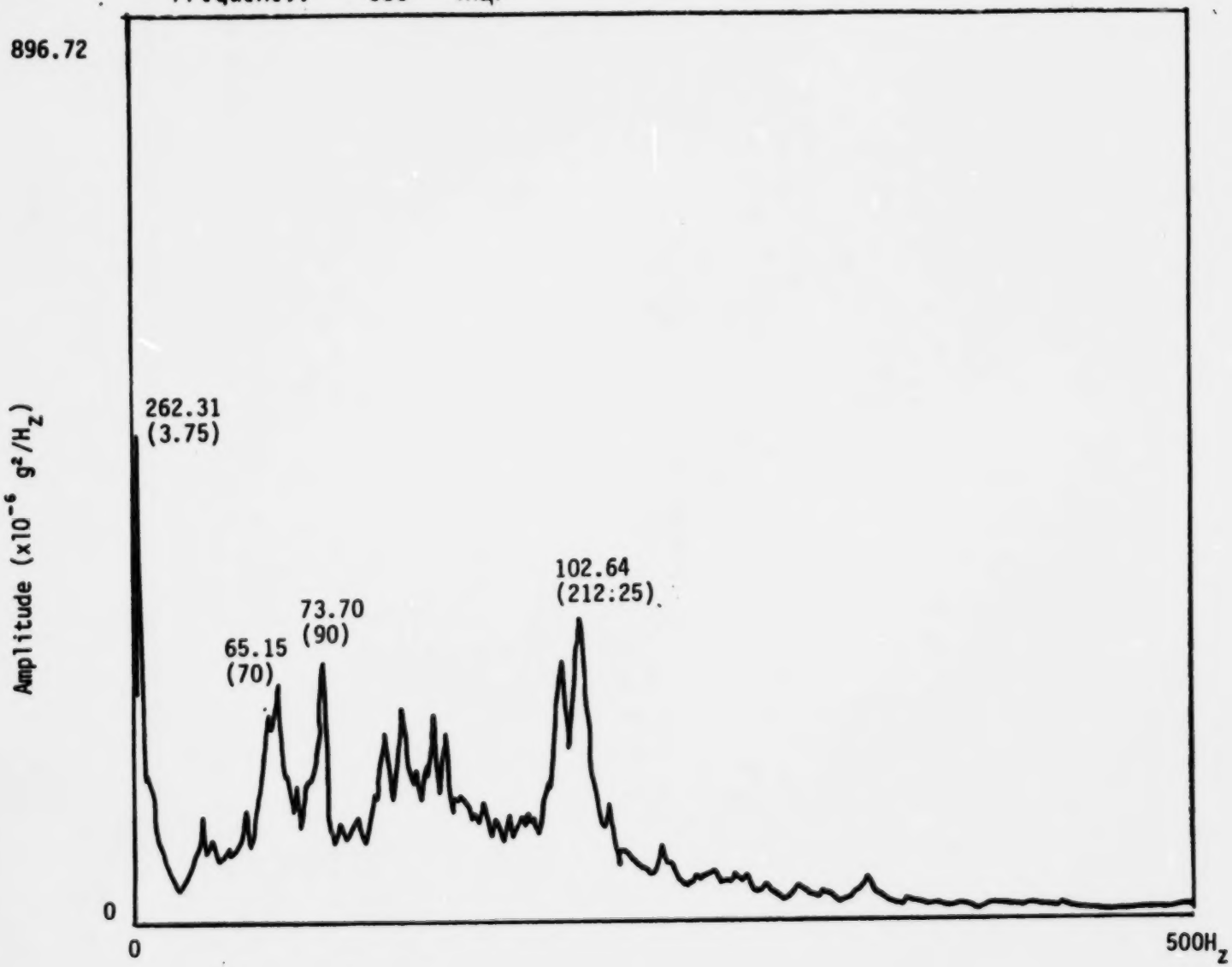


FIGURE 6.8c PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts 1.5′ Thk)
Vessel : USCGC POLAR SEA Test Time : 81:01:31:14:10
Sensor : 'SURGE'' Calibration: .9591 (g'/v)
Frequency: 500 (Hz)

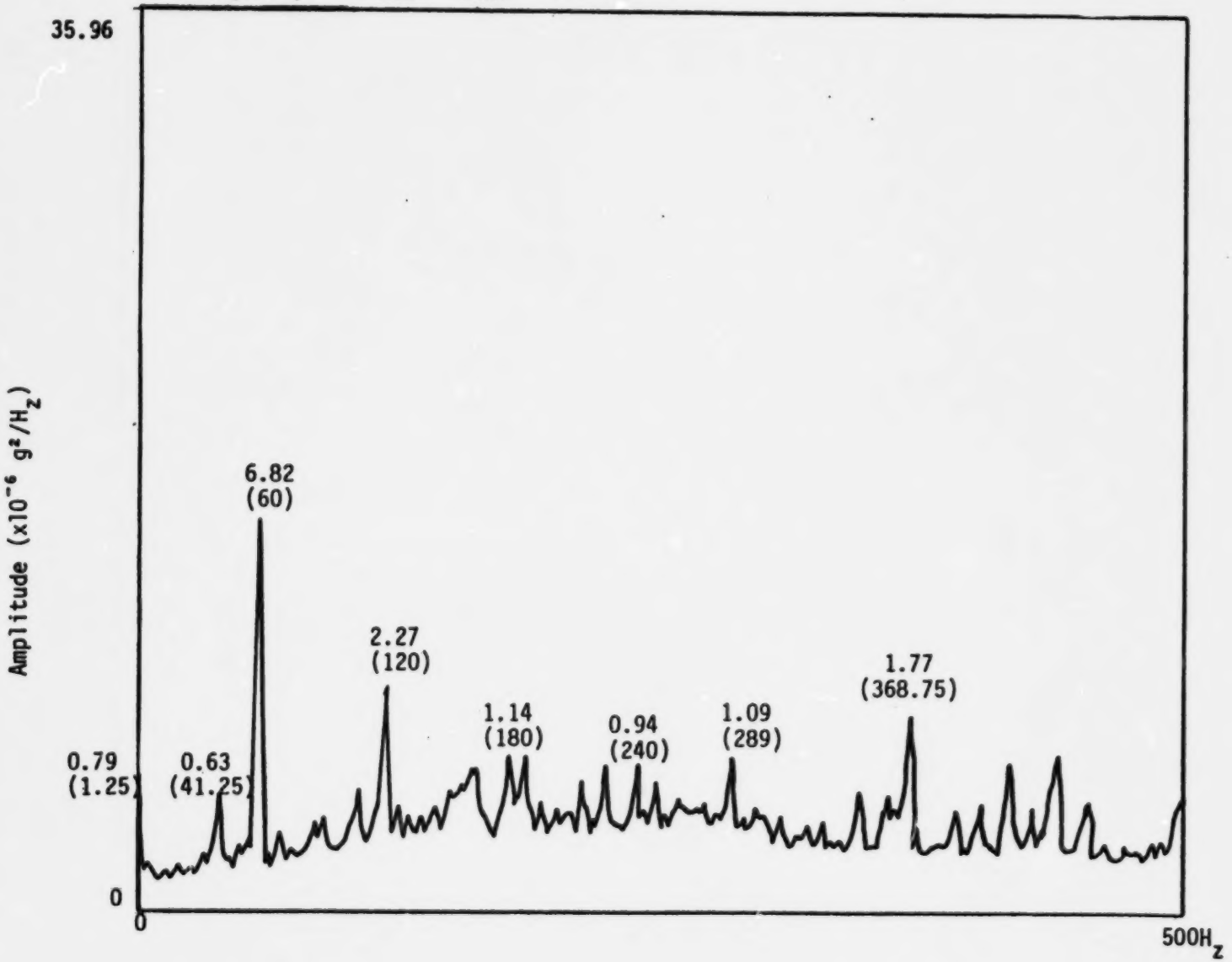


FIGURE 6.8d PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts 1.5′ Thk)
Vessel : USCGC POLAR SEA Test Time : 81:01:31:14:10
Sensor : 'SWAY'
Frequency: 500 (Hz) Calibration: .9547 (g′/v)

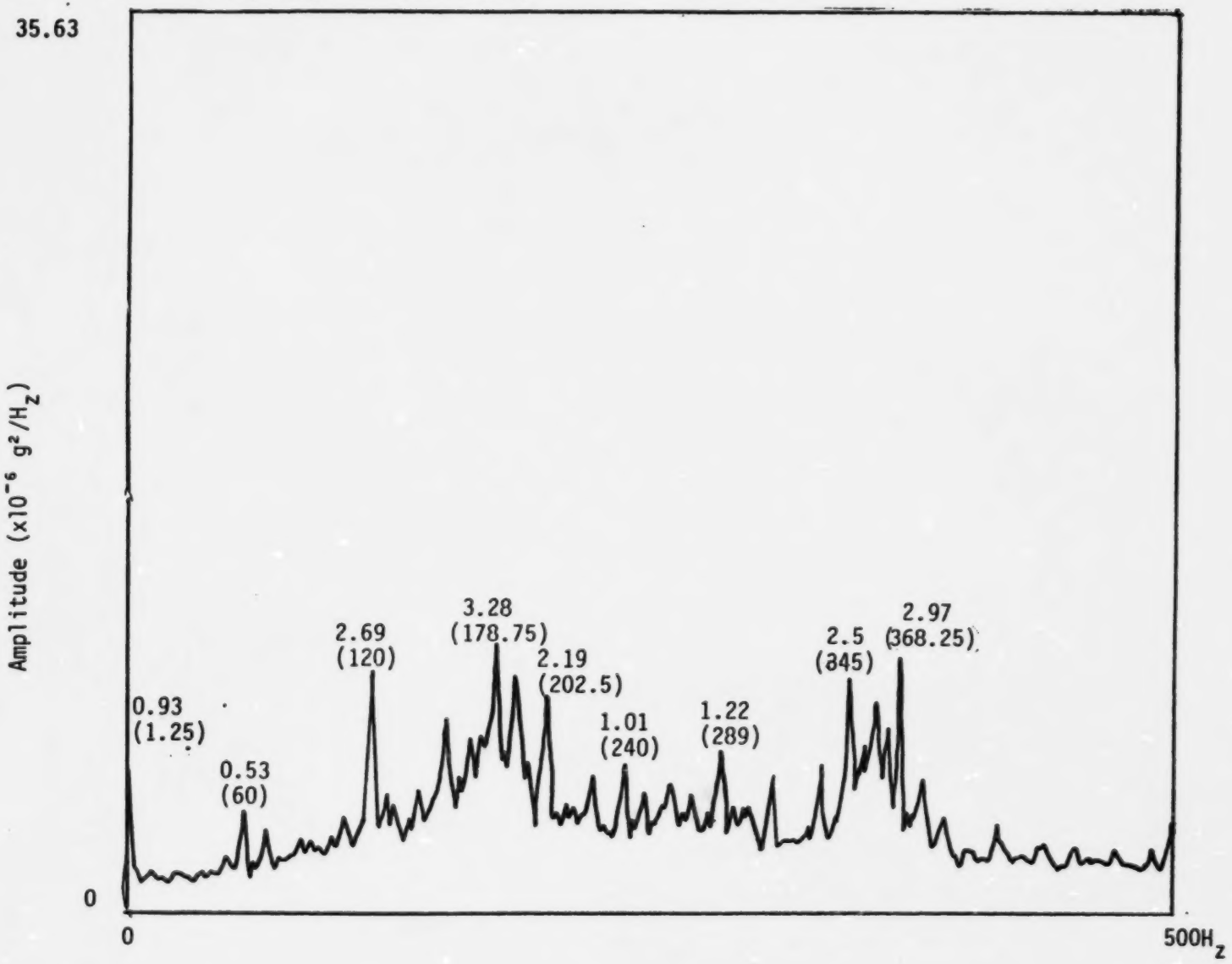


FIGURE 6.8e PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts 1.5' Thk)
Vessel : USCGC POLAR SEA
Sensor : 'HEAVE'
Frequency: 500 (Hz)
Test Time : 81:01:31:14:10
Calibration: .9603 (g'/v)

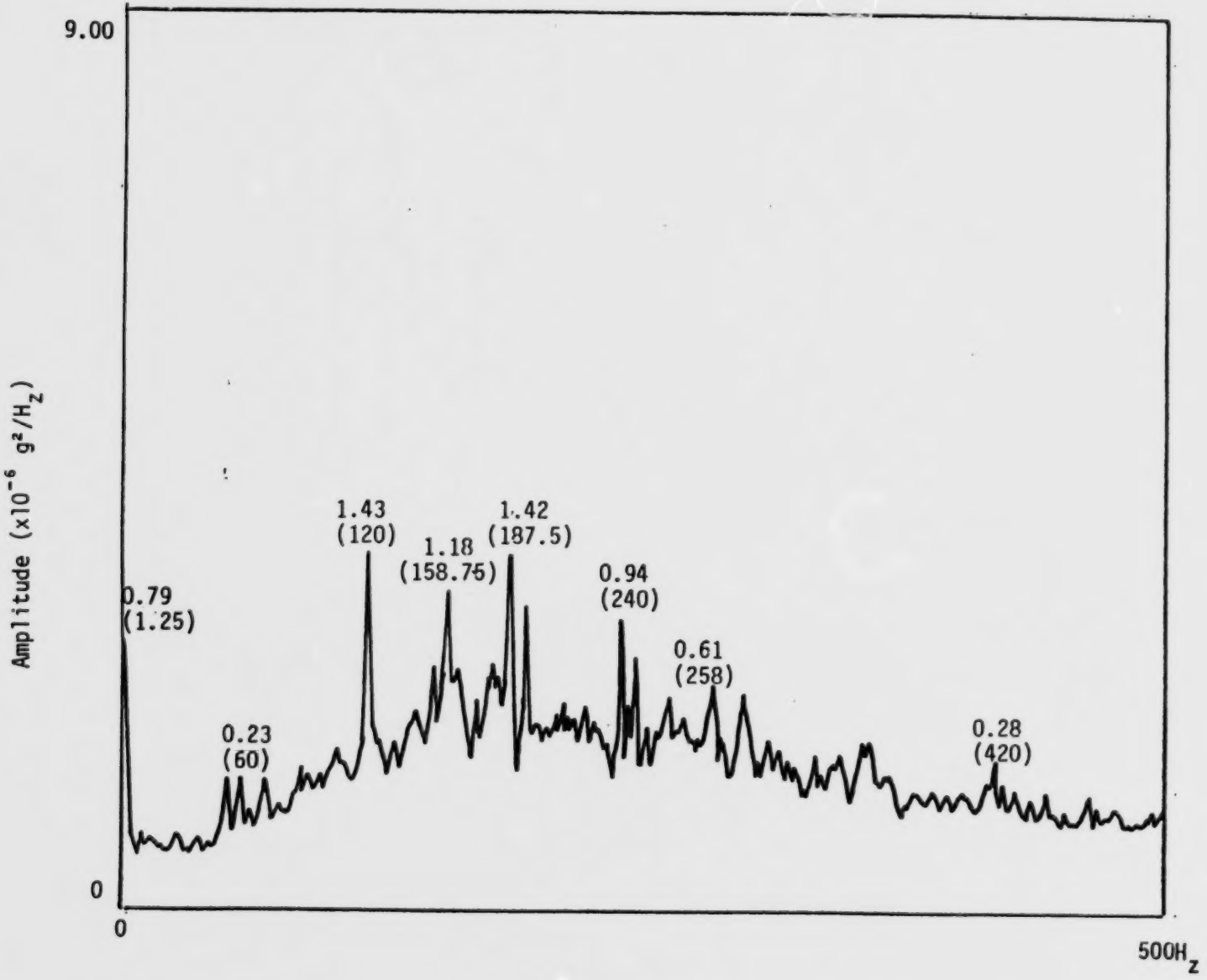


FIGURE 6.8f PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts 1.5′ Thk)
Vessel : USCGC POLAR SEA Test Time : 81:01:31:14:10
Sensor : 'AFT SURGE' Calibration: 1.1834 (g′/v)
Frequency: 500 (Hz)

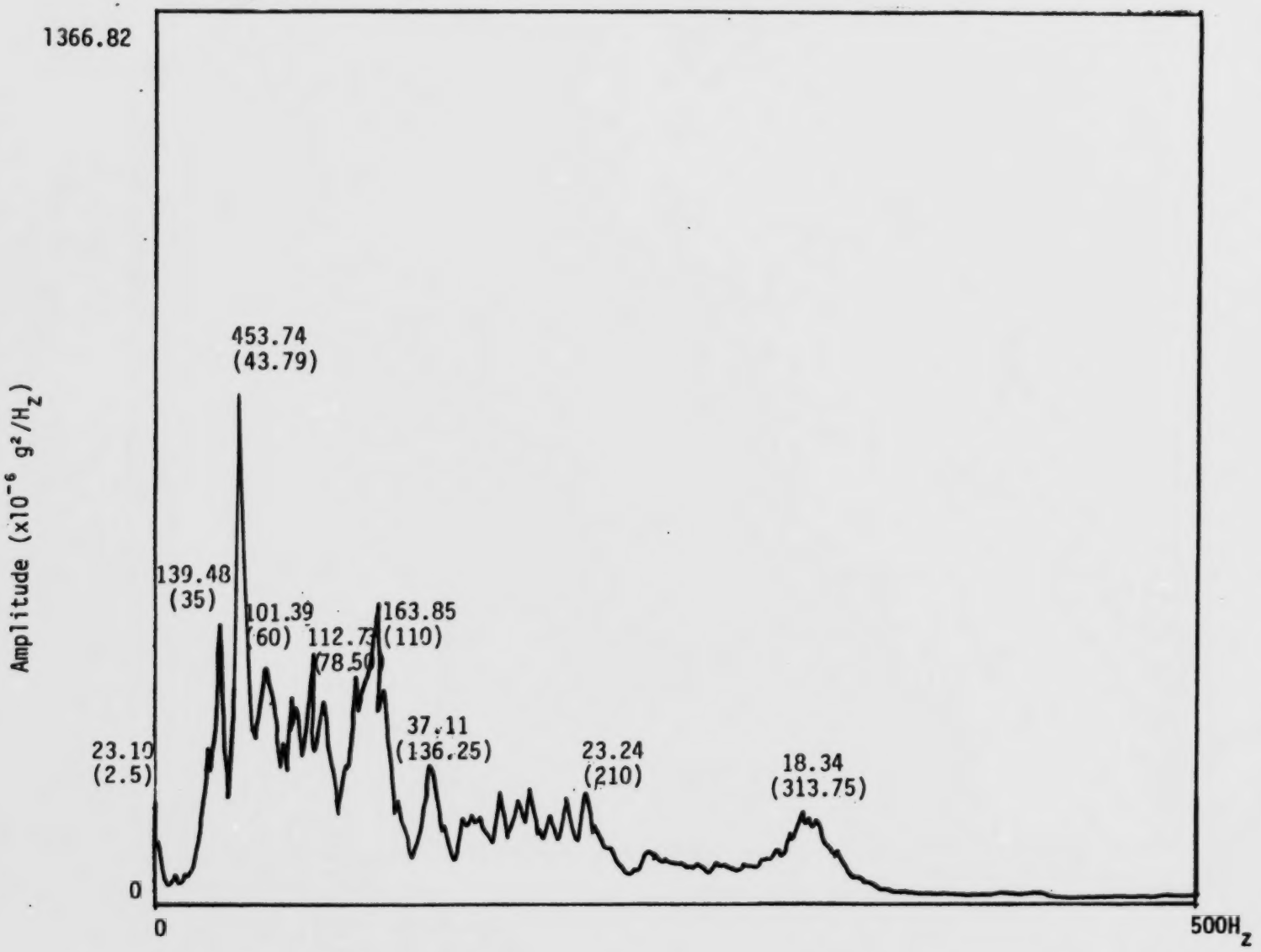


FIGURE 6.8g PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts 1.5' Thk)
Vessel : USCGC POLAR SEA Test Time : 81:01:31:14:10
Sensor : 'AFT SWAY' Calibration: 1.2270 (g'/v)
Frequency: 500 (Hz)

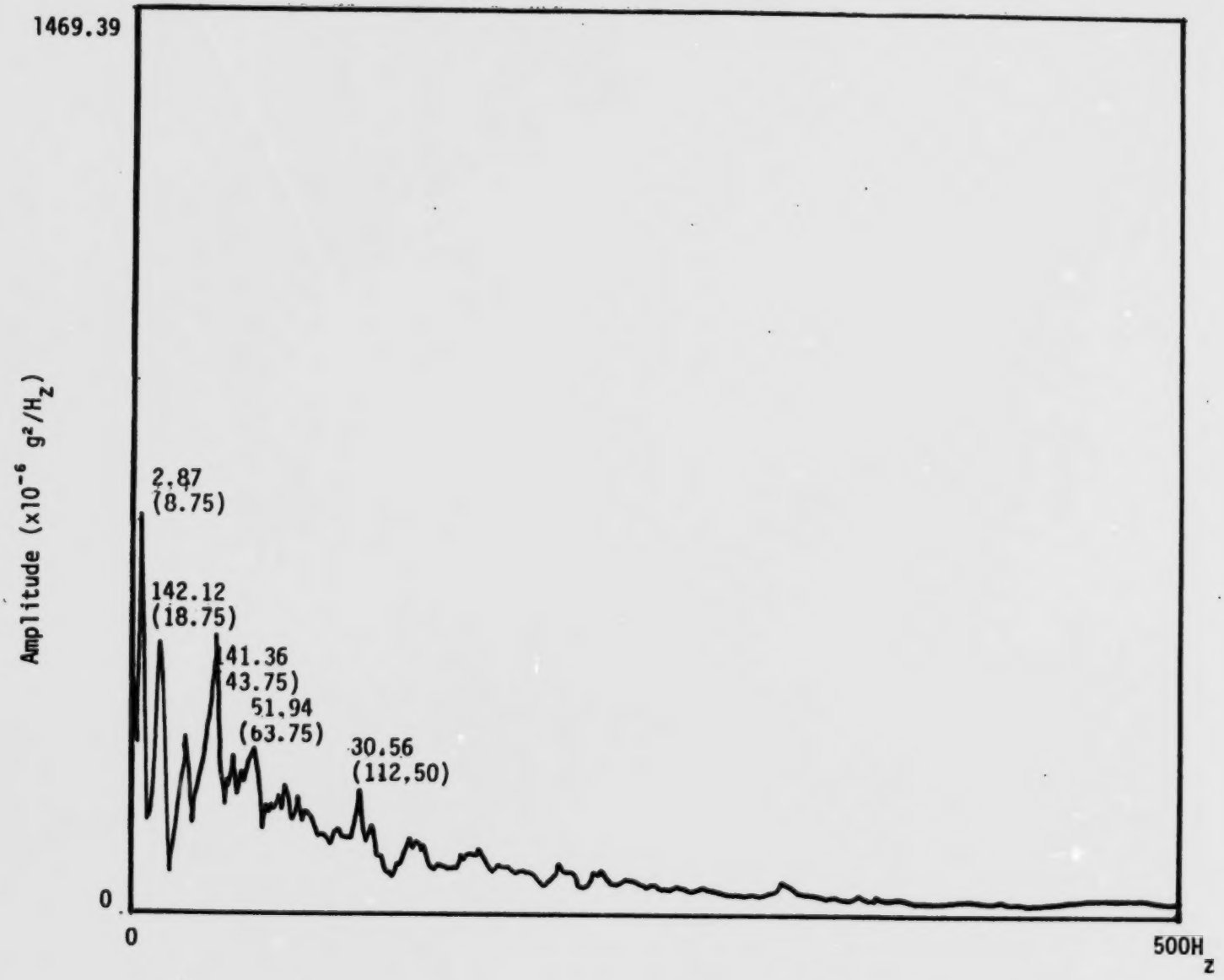


FIGURE 6.8h PEAK AVERAGE ACCELERATION SPECTRUM

Event :CONTINUOUS TRANSIT IN LEVEL ICE (6 Kts 1.5' Thk)
Vessel : USCGC POLAR SEA Test Time : 81:01:31:14:10
Sensor : 'AFT HEAVE' Calibration: 1.2345 (g'/v)
Frequency: 500 (Hz)

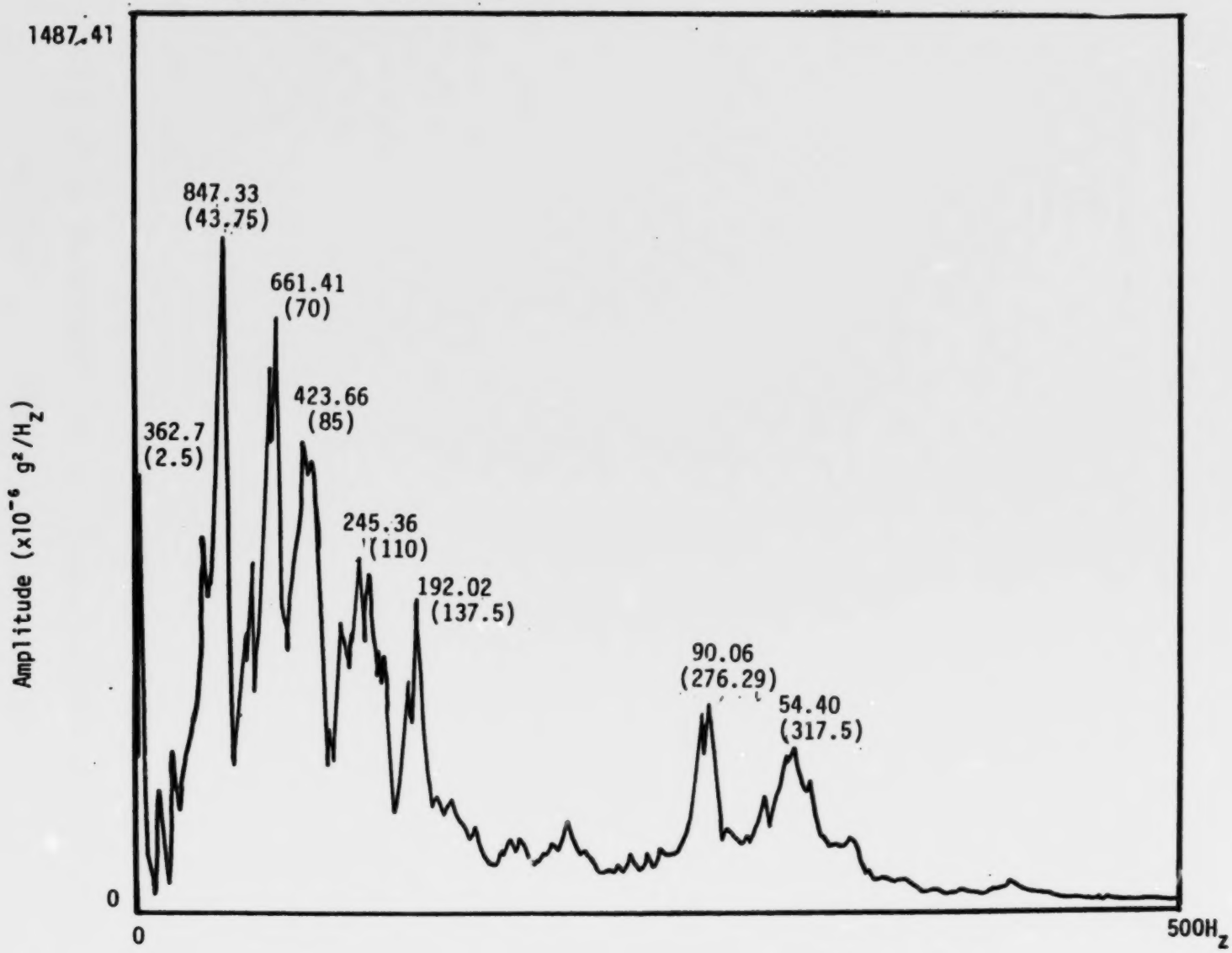


FIGURE 6.9a PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4′ avg. 3.5′)
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : 'BOW SWAY' Calibration: 1.1940 (g′/v)
Frequency: 50 (Hz)

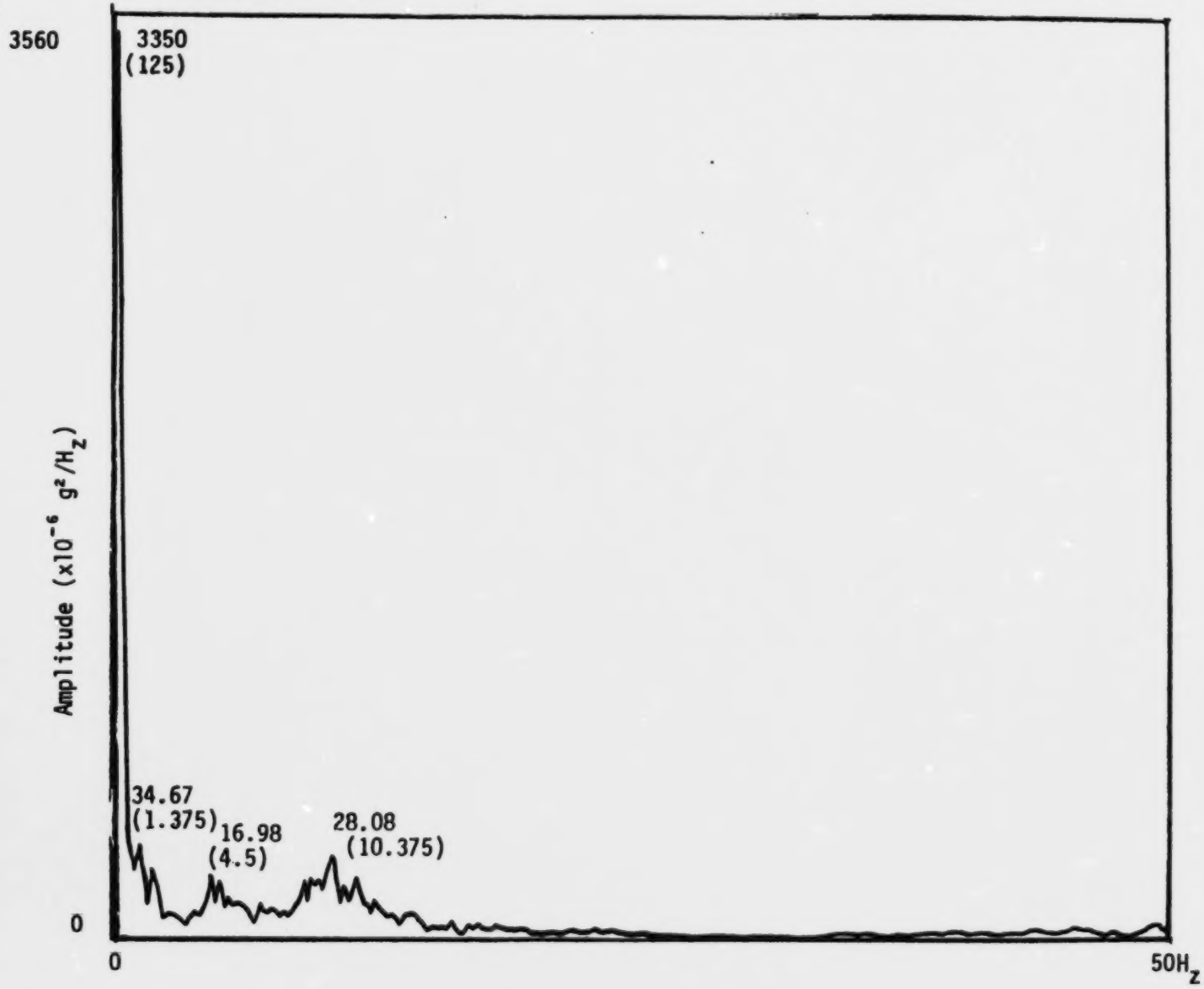


FIGURE 6.9b PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3.5')
Vessel : USCGC POLAR SEA
Sensor : 'BOW HEAVE'
Frequency: 50 (Hz)
Test Time : 81:02:08:02:30
Calibration: 1.2500 (g'/v)

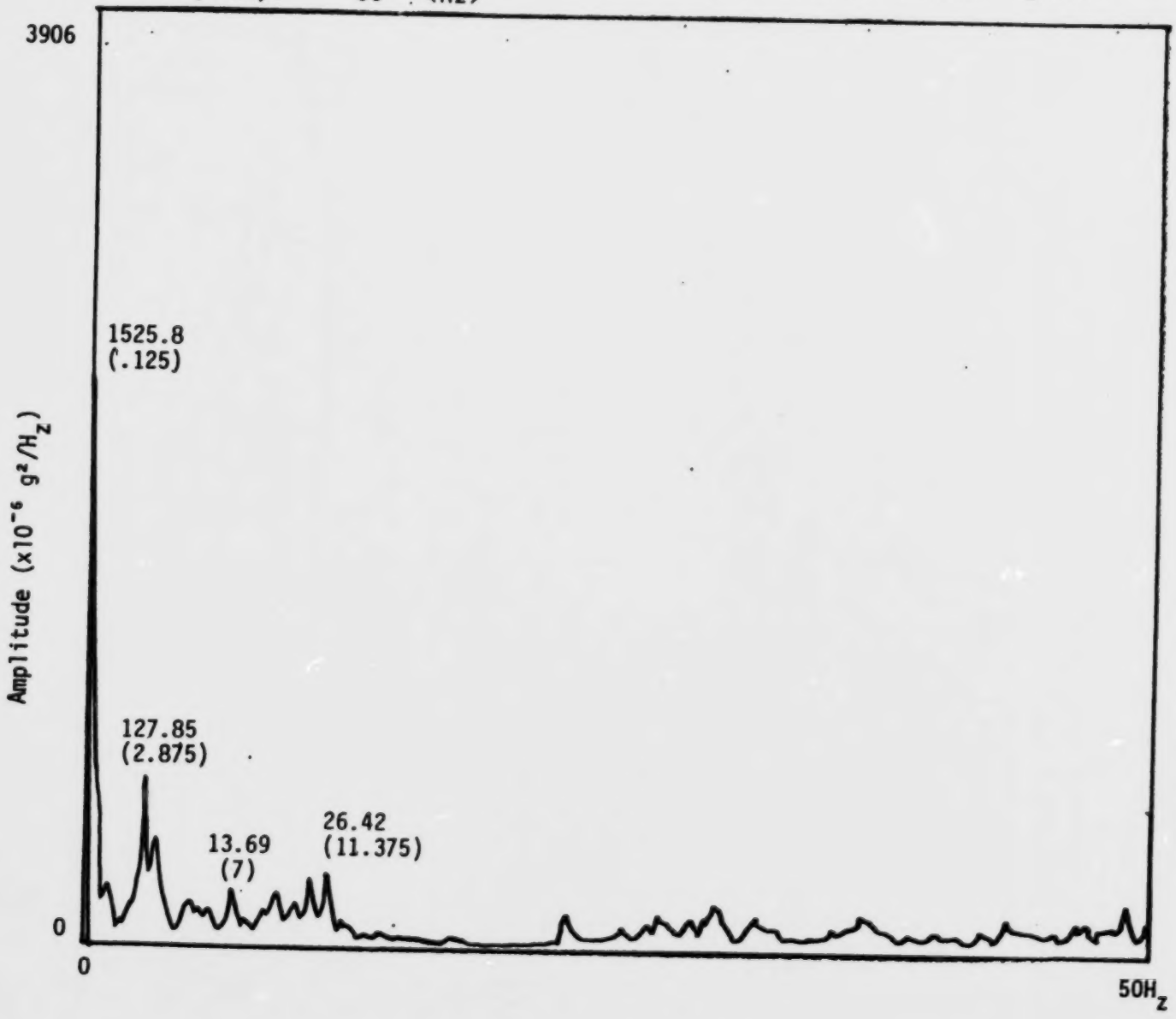


FIGURE 6.9c PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3.5')
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : 'SURGE' Calibration: .9591 (g'/v)
Frequency: 50 (Hz)

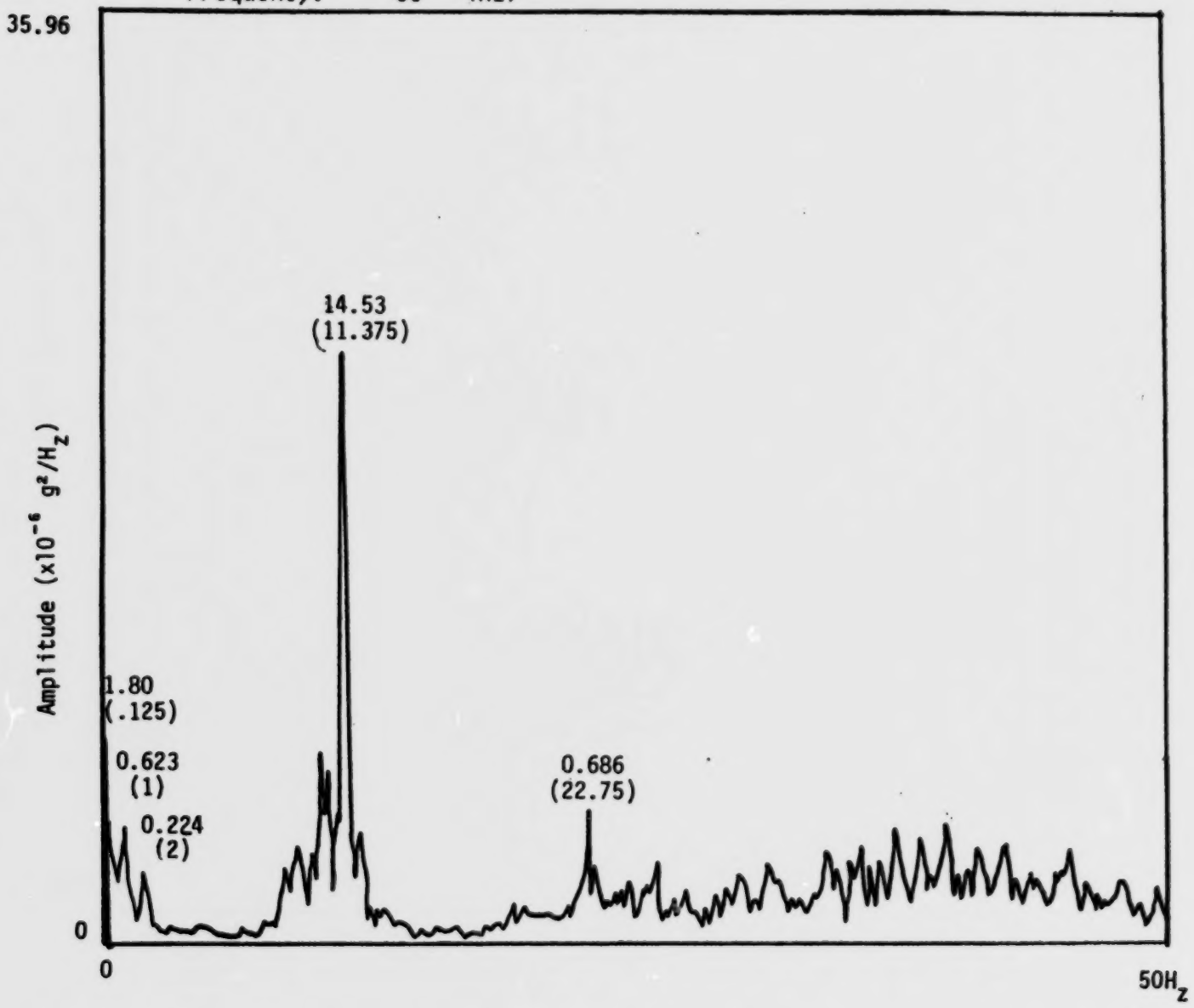


FIGURE 6.9d PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3.5')
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : 'SWAY' Calibration: .9547 (g'/v)
Frequency: 50 (Hz)

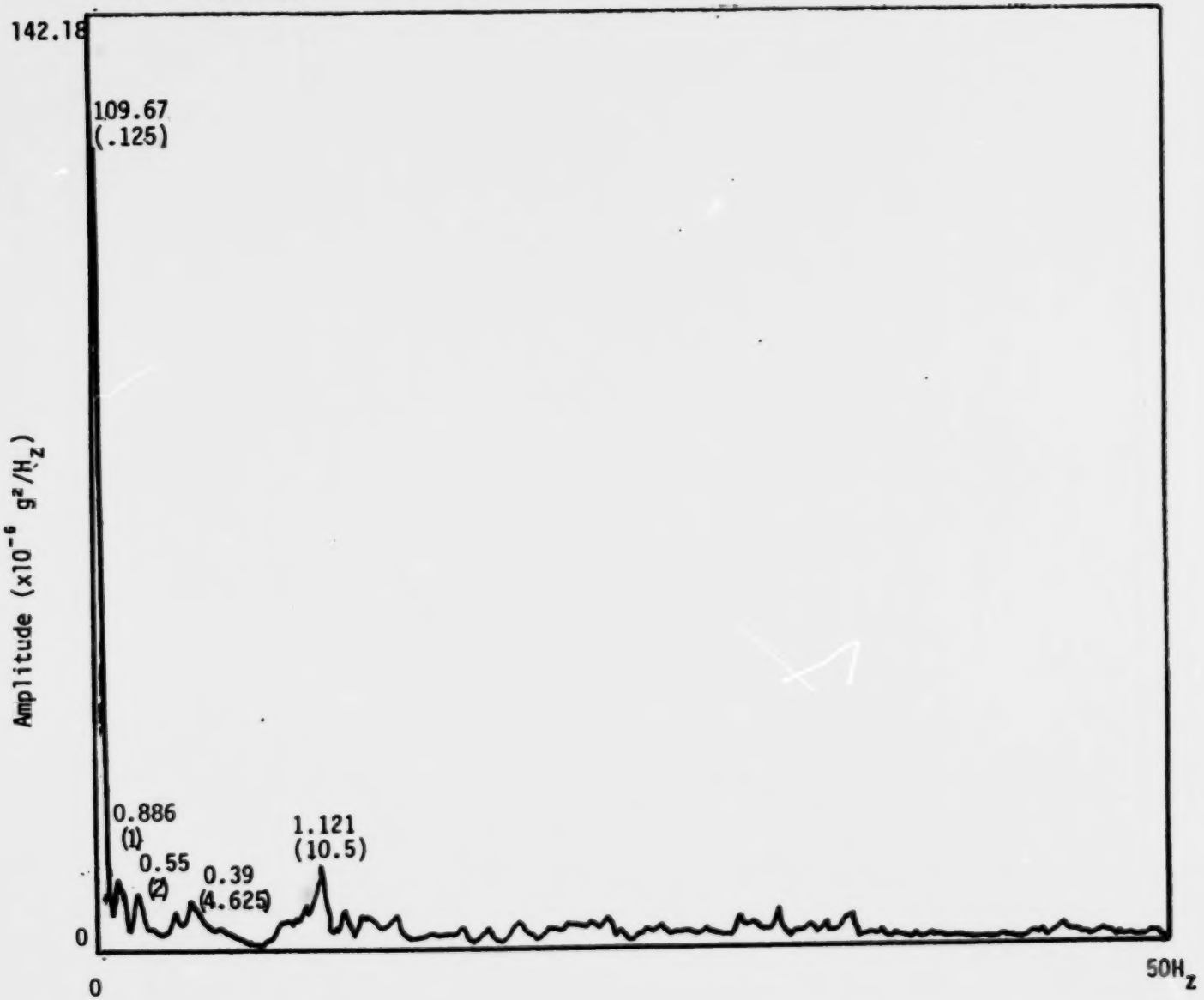


FIGURE 6.9e PEAK AVERAGE ACCELERATION SPECTRUM

Event : RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3.5')
Vessel : USCGC POLAR SEA
Sensor : 'HEAVE'
Frequency: 50 (Hz)
Test Time : 81:02:08:02:30
Calibration: .9603 (g'/v)

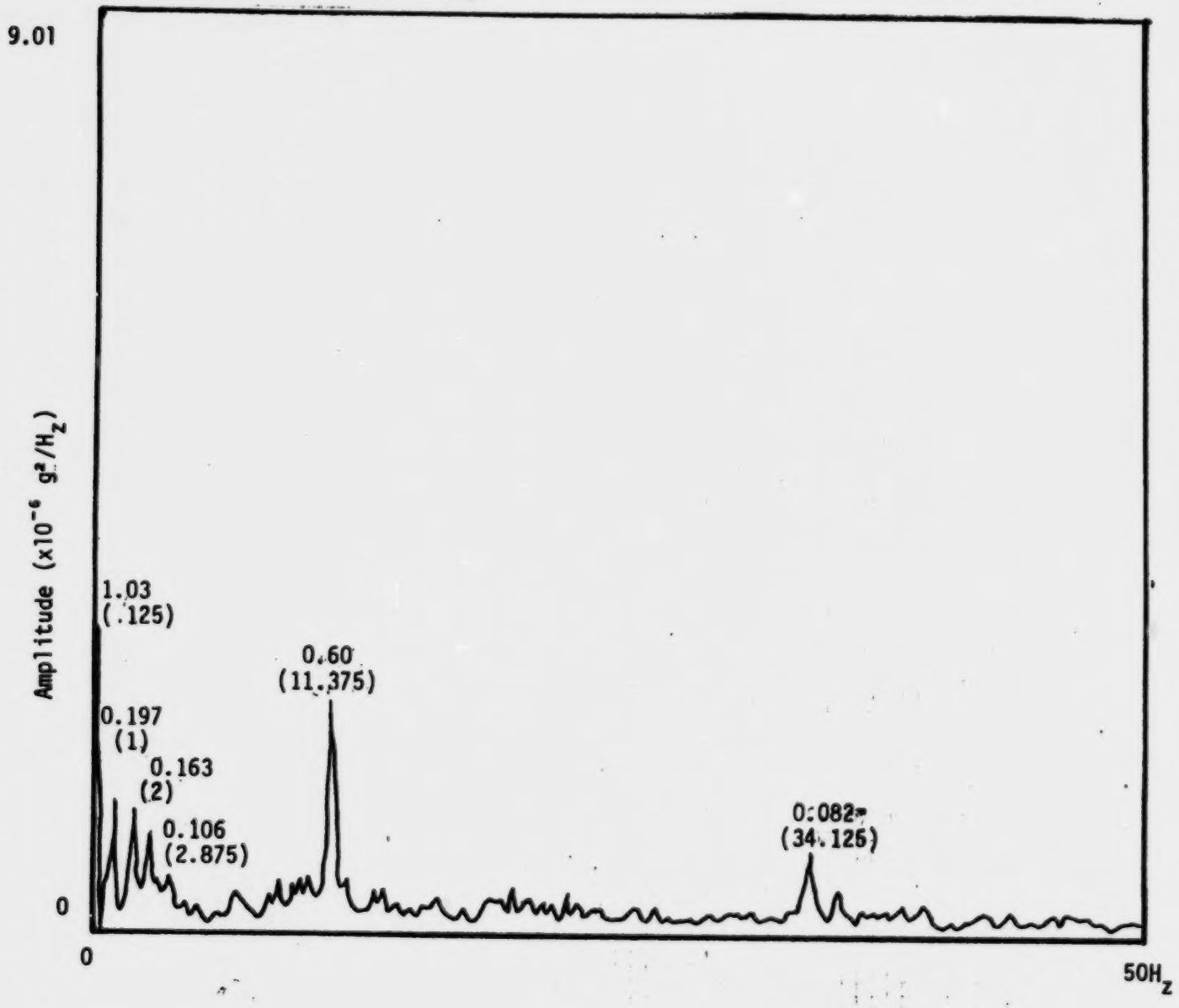


FIGURE 6.9f PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3.5')
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : 'AFT SURGE' Calibration: 1.1834 (g'/v)
Frequency: 50 (Hz)

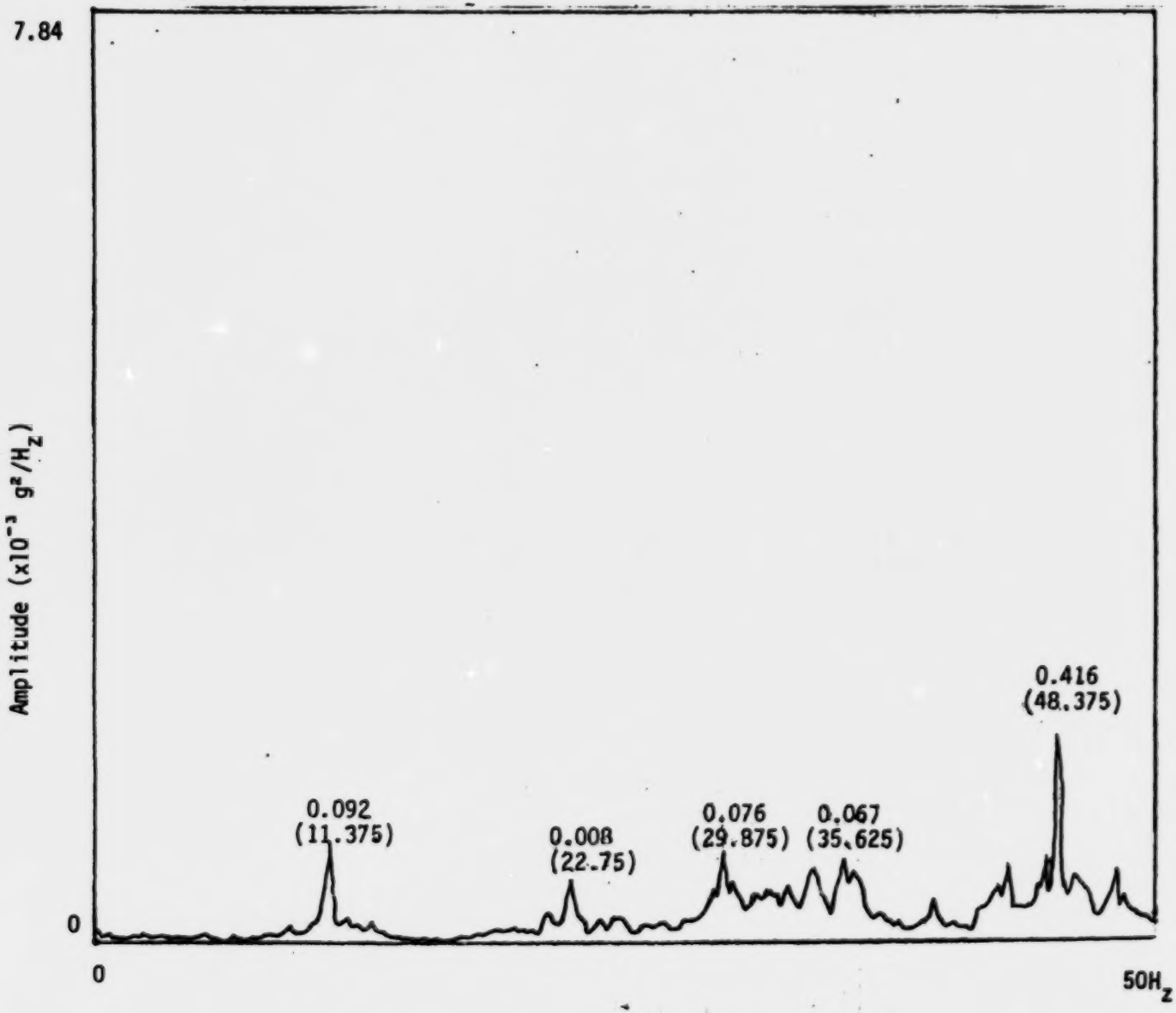


FIGURE 6.9g PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3.5')
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : 'AFT SWAY' Calibration: 1.2270 (g''/v)
Frequency: 50 (Hz)

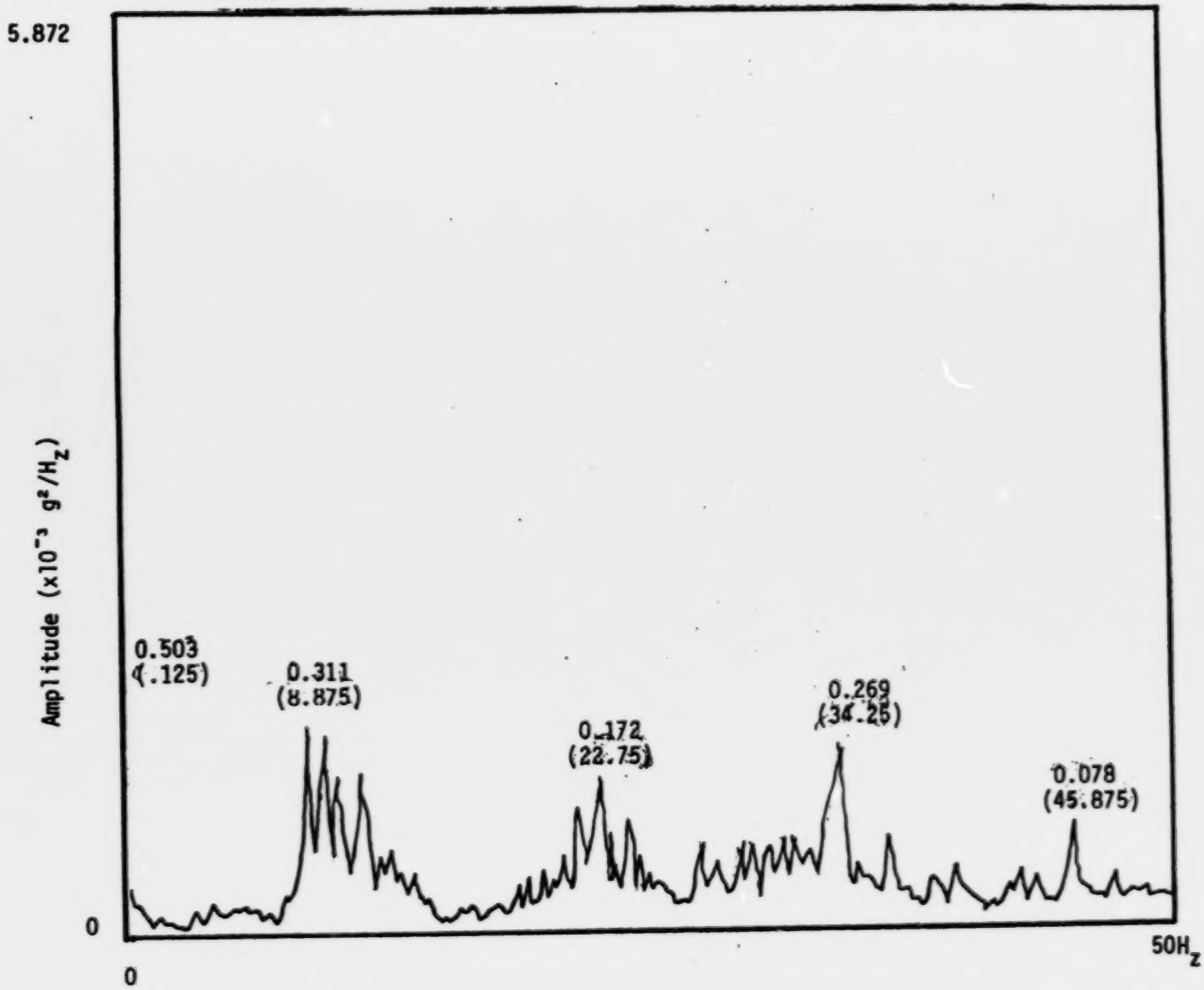


FIGURE 6.9h PEAK AVERAGE ACCELERATION SPECTRUM

Event : RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3.5')
Vessel : USCGC POLAR SEA
Sensor : 'AFT HEAVE'
Frequency: 50 (Hz)
Test Time : 81:02:08:02:30
Calibration: 1.2345 (g'/v)

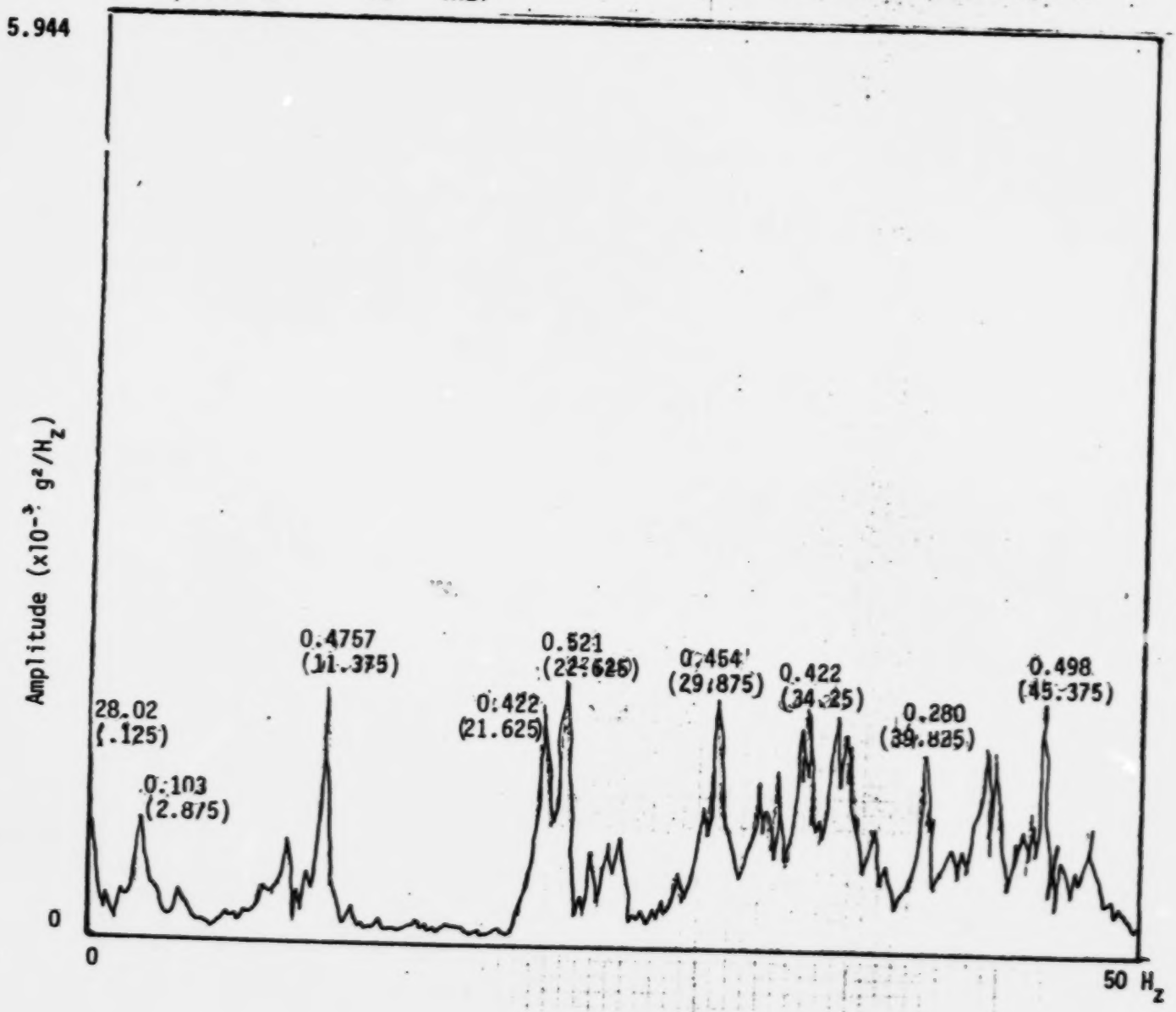


FIGURE 6.10a PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA Test Time : 81:02:09:06:20
Sensor : 'BOW SWAY' Calibration: 1.1940 (g'/v)
Frequency: 50 (Hz)

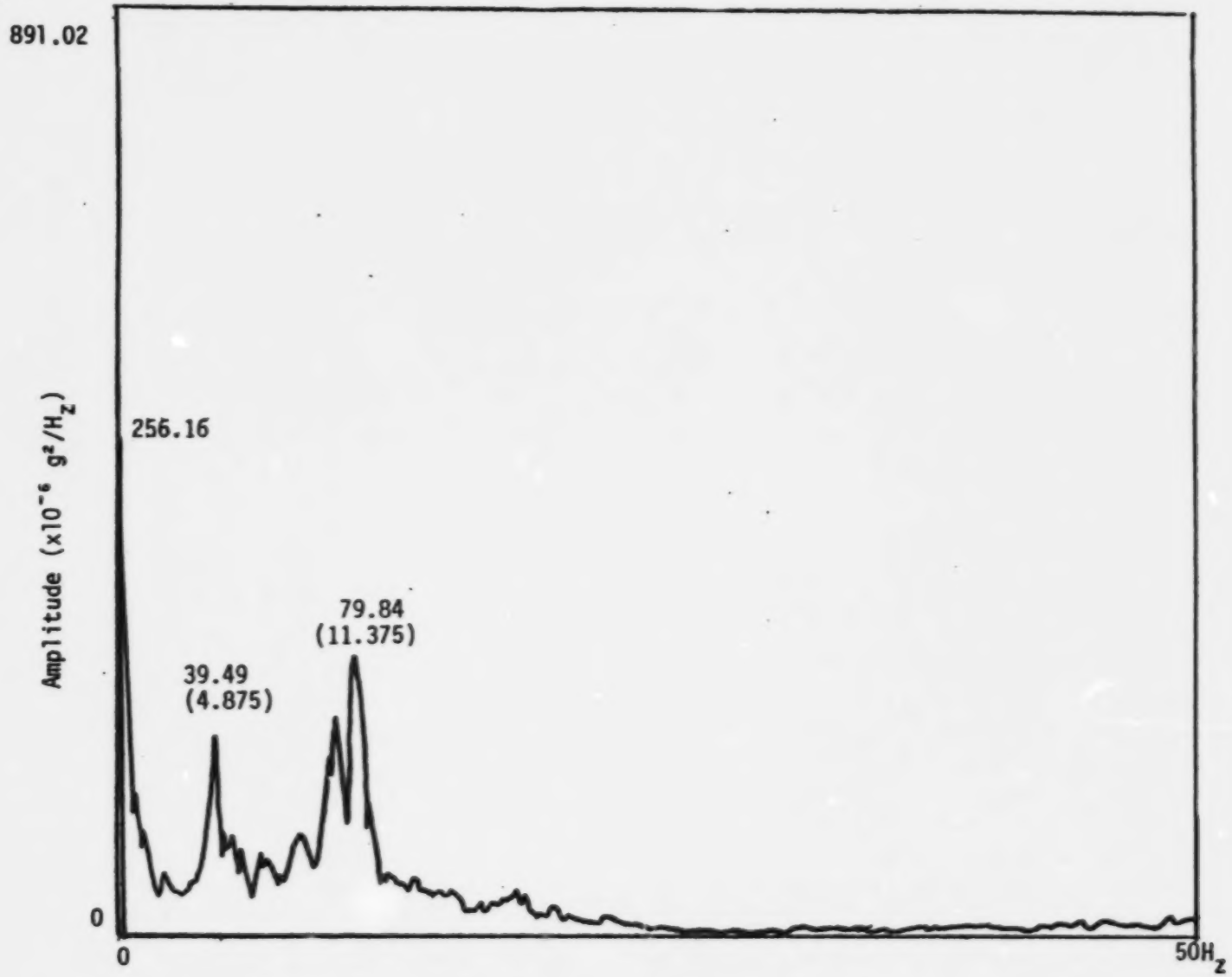


FIGURE 6.10b PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA Test Time : 81:02:09:06:20
Sensor : 'BOW HEAVE' Calibration: 1.2500 (g'/v)
Frequency: 50 (Hz)

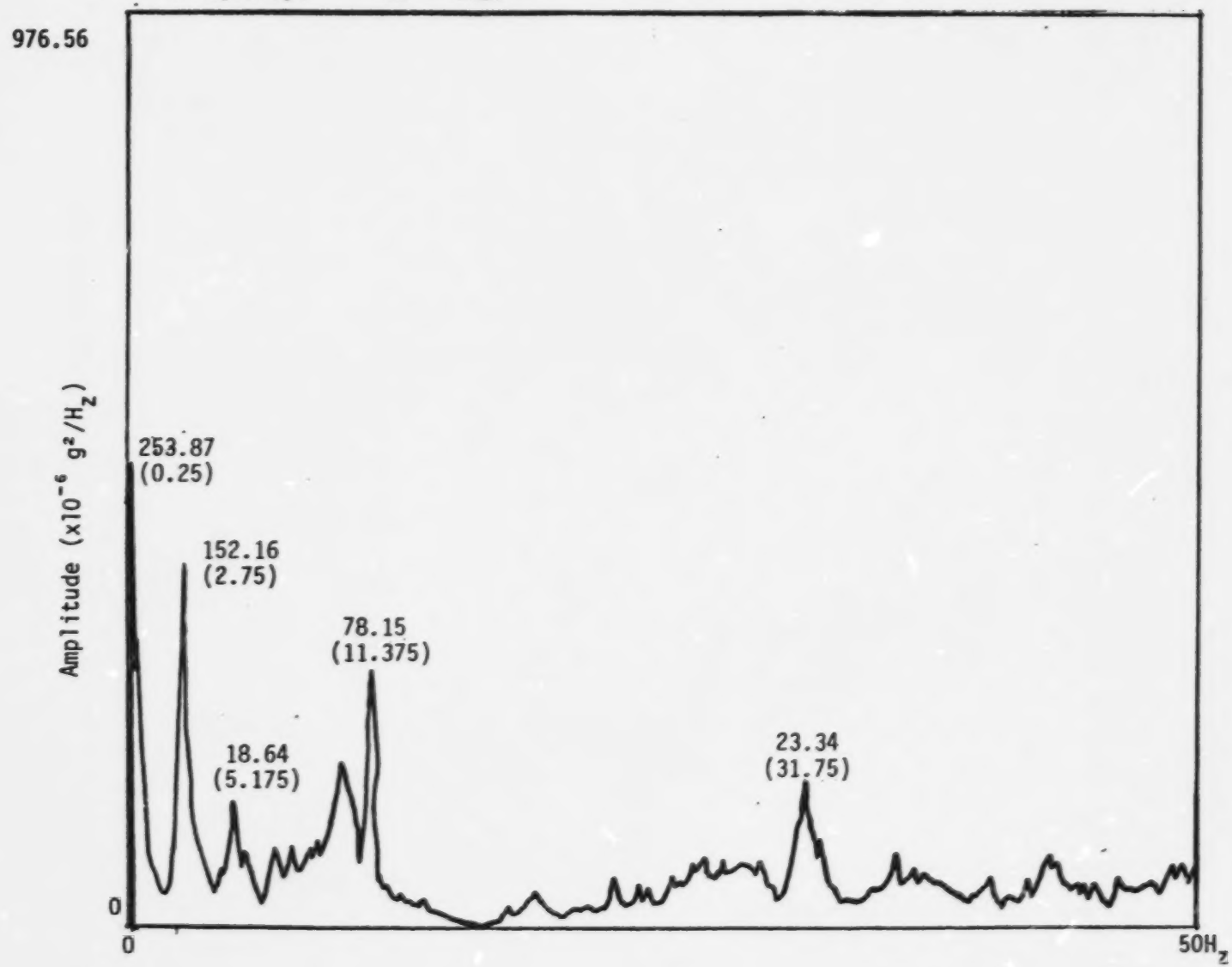


FIGURE 6.10c PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA Test Time : 81:02:09:06:20
Sensor : 'SURGE' Calibration: 9531 (g'/v)
Frequency: 50 (Hz)

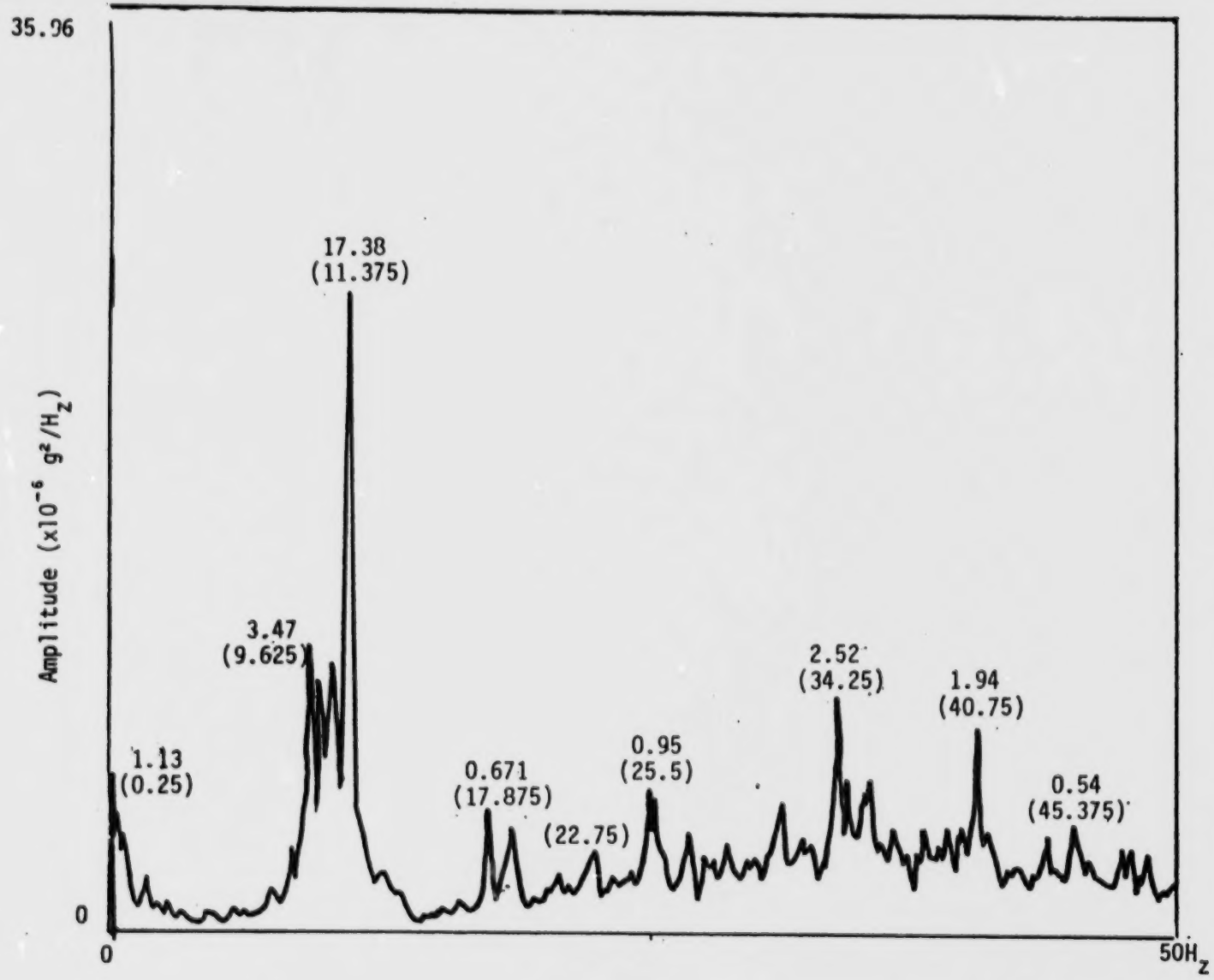


FIGURE 6.10d PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA Test Time : 81:02:09:06:20
Sensor : 'SWAY' Calibration: .9547 (g'/v)
Frequency: 50 (Hz)

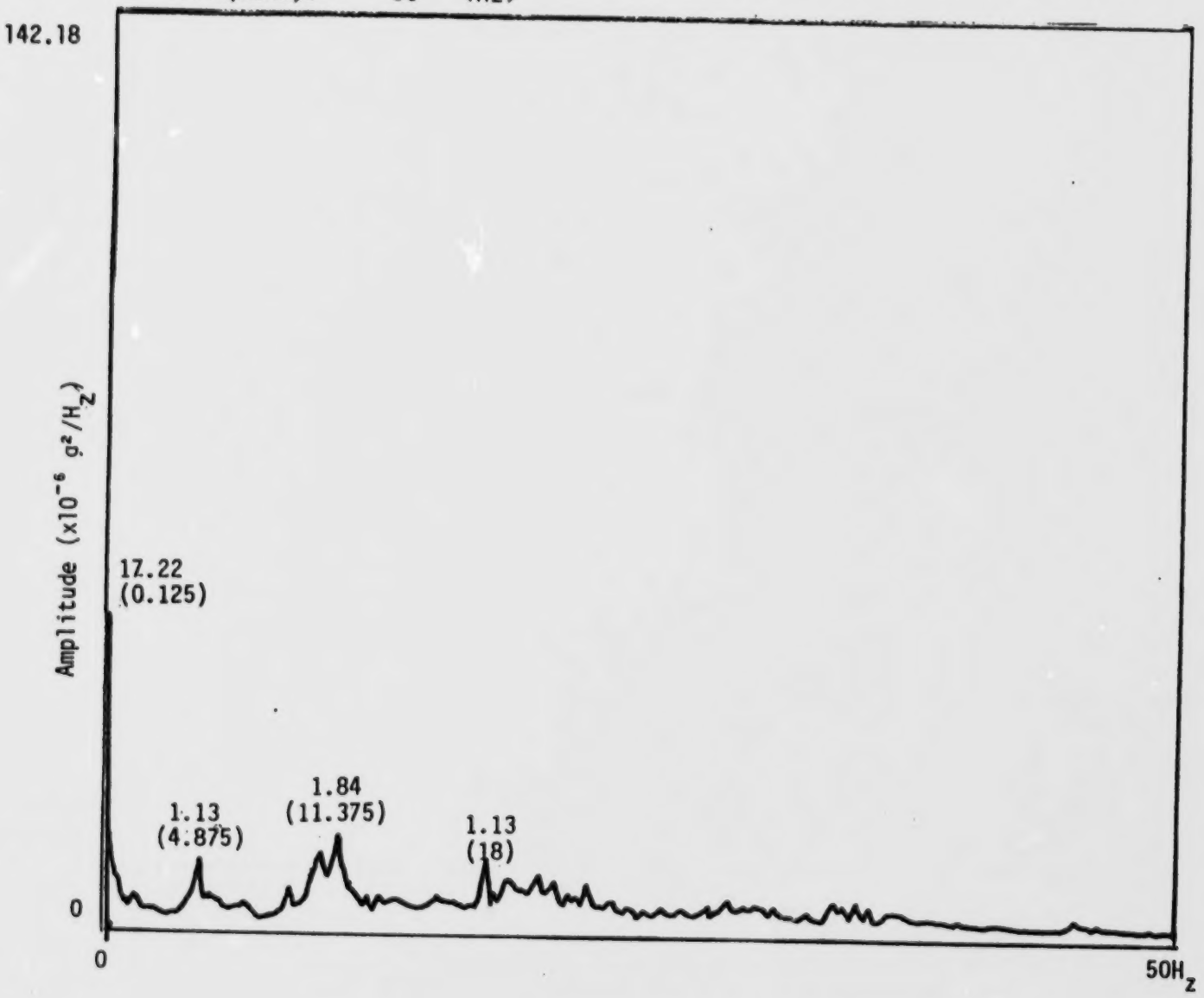


FIGURE 6.10e PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA
Sensor : 'HEAVE'
Frequency: 50 (Hz)
Test Time : 81:02:09:06:20
Calibration: .9603 (g'/v)

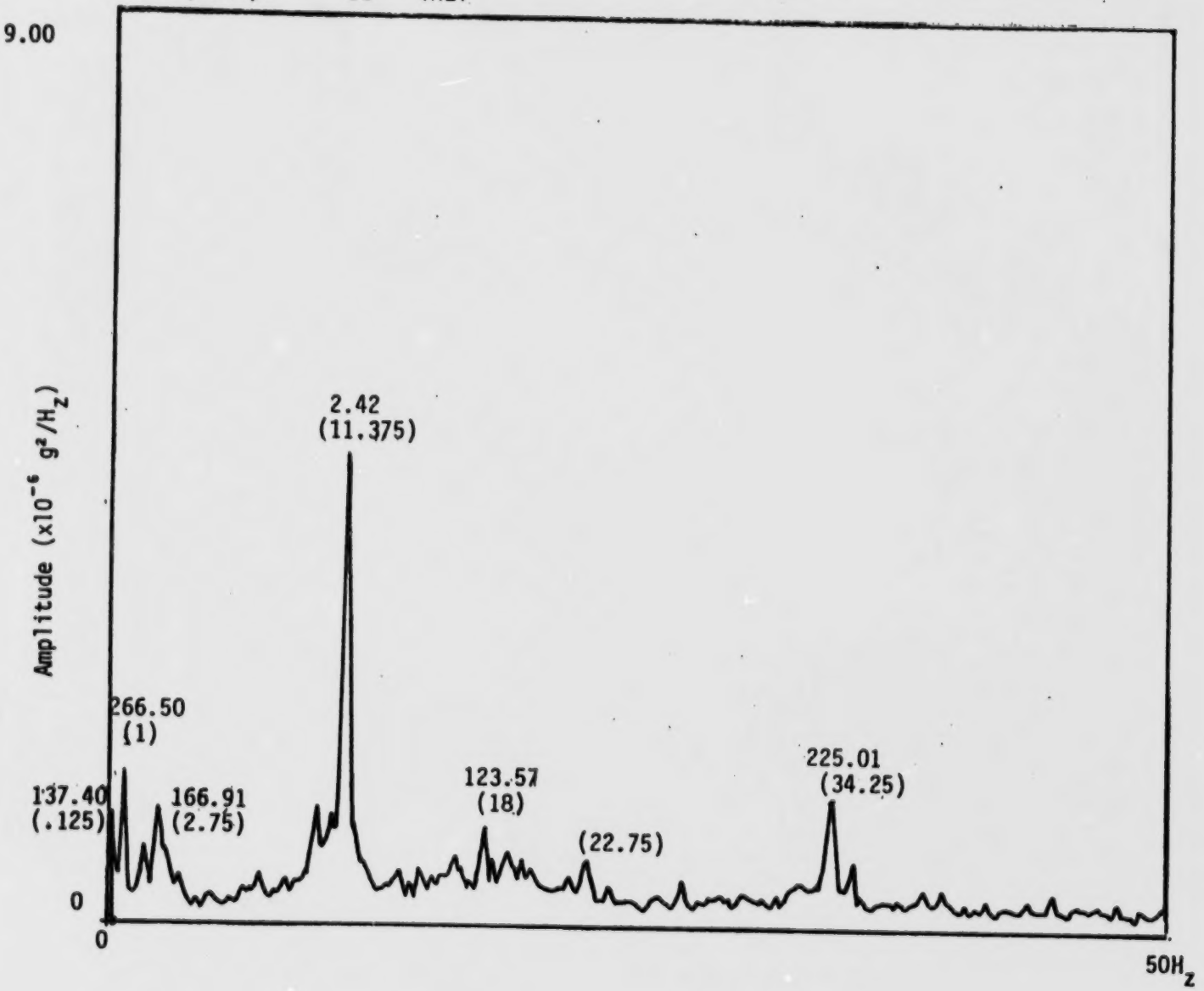


FIGURE 6.10f PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA
Sensor : 'AFT SURGE'
Frequency: 50 (Hz)
Test Time : 81:02:09:06:20
Calibration: 1.1834 (g'/v)

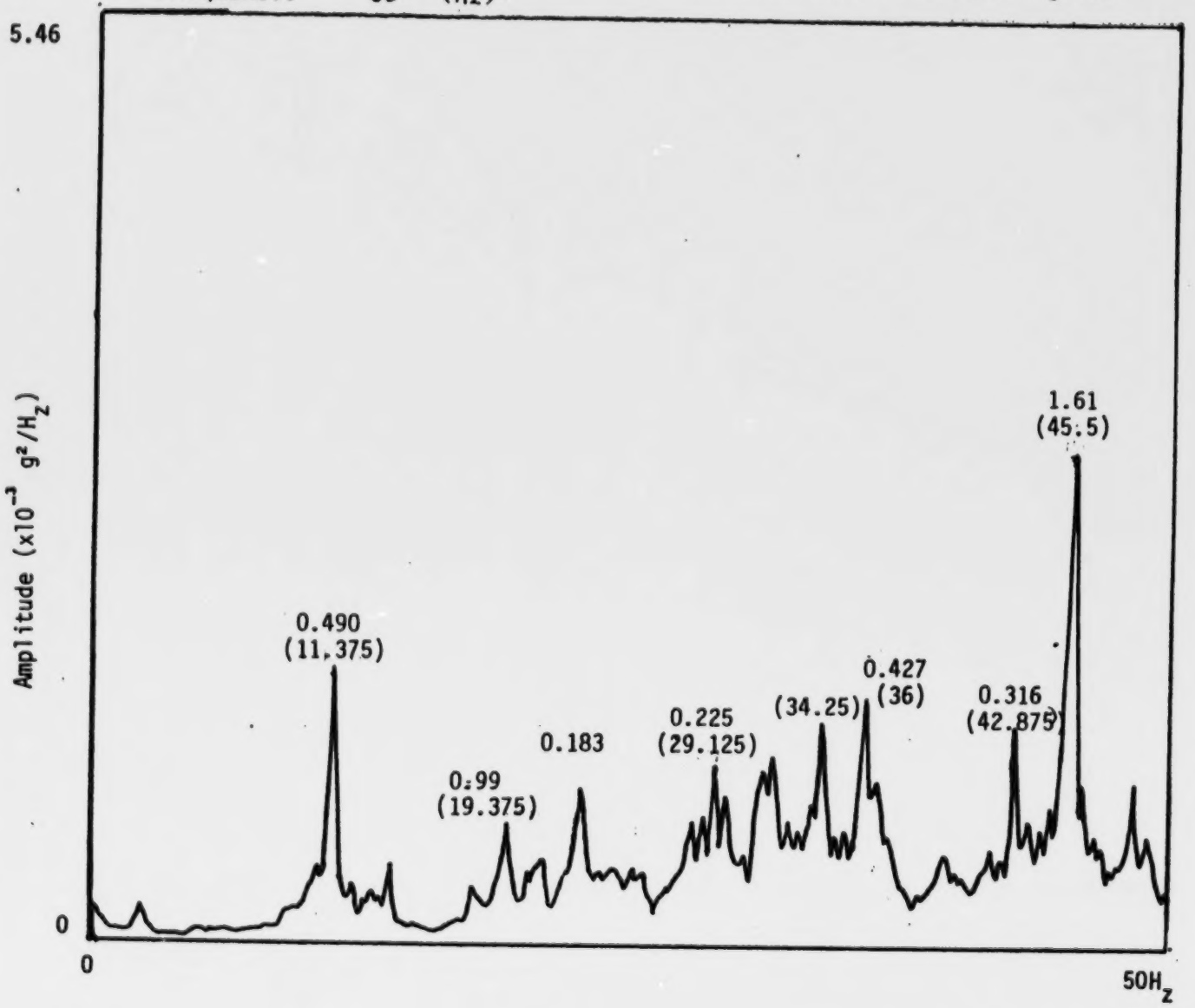


FIGURE 6.10g PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA
Sensor : 'AFT SWAY'
Frequency: 50 (Hz)
Test Time : 81:02:09:06:20
Calibration: 1.2270 (g'/v)

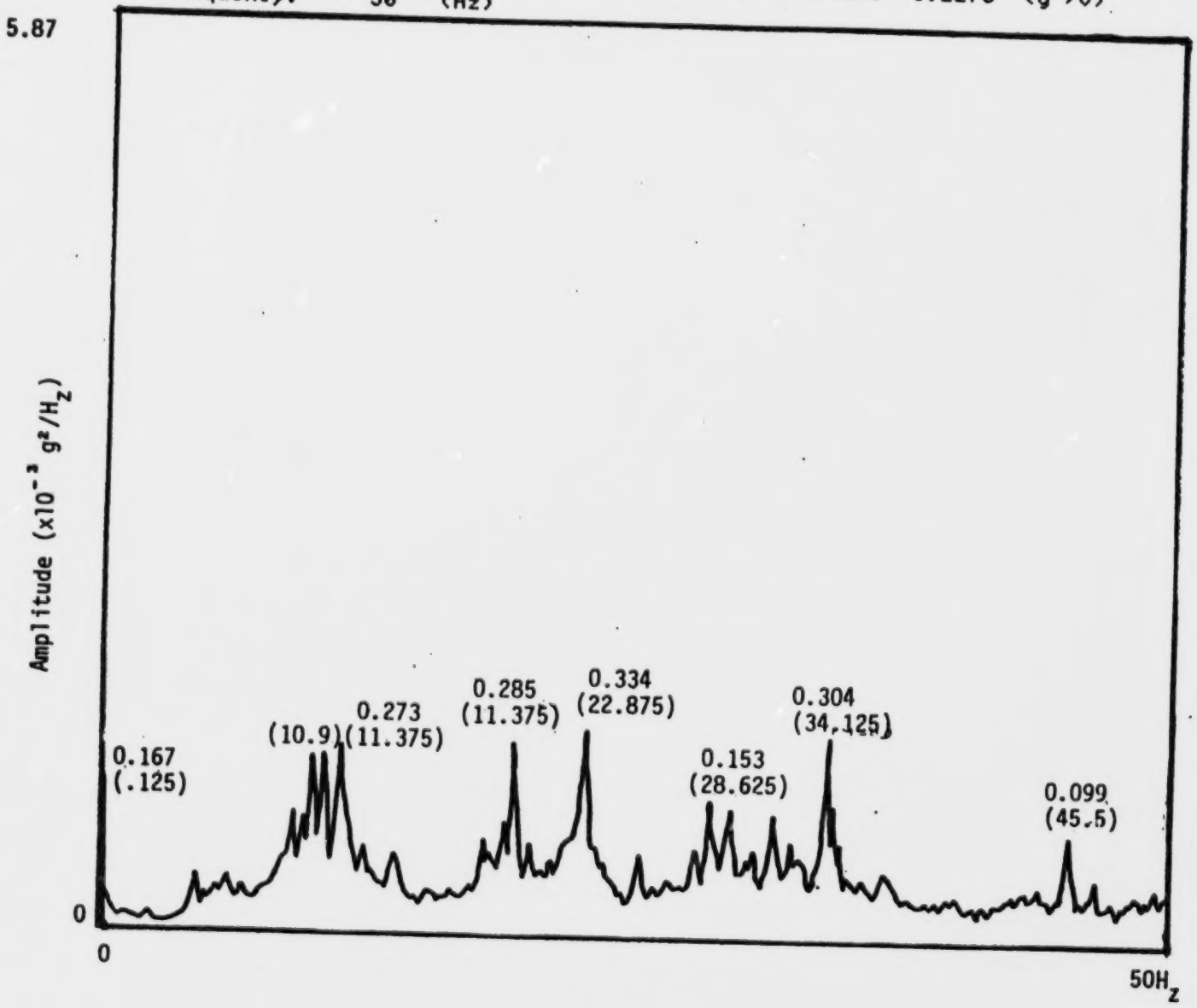


FIGURE 6.10h PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (OBLIQUE 9 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA Test Time : 81:02:09:06:20
Sensor : 'AFT HEAVE' Calibration: 1.2345 (g'/v)
Frequency: 50 (Hz)

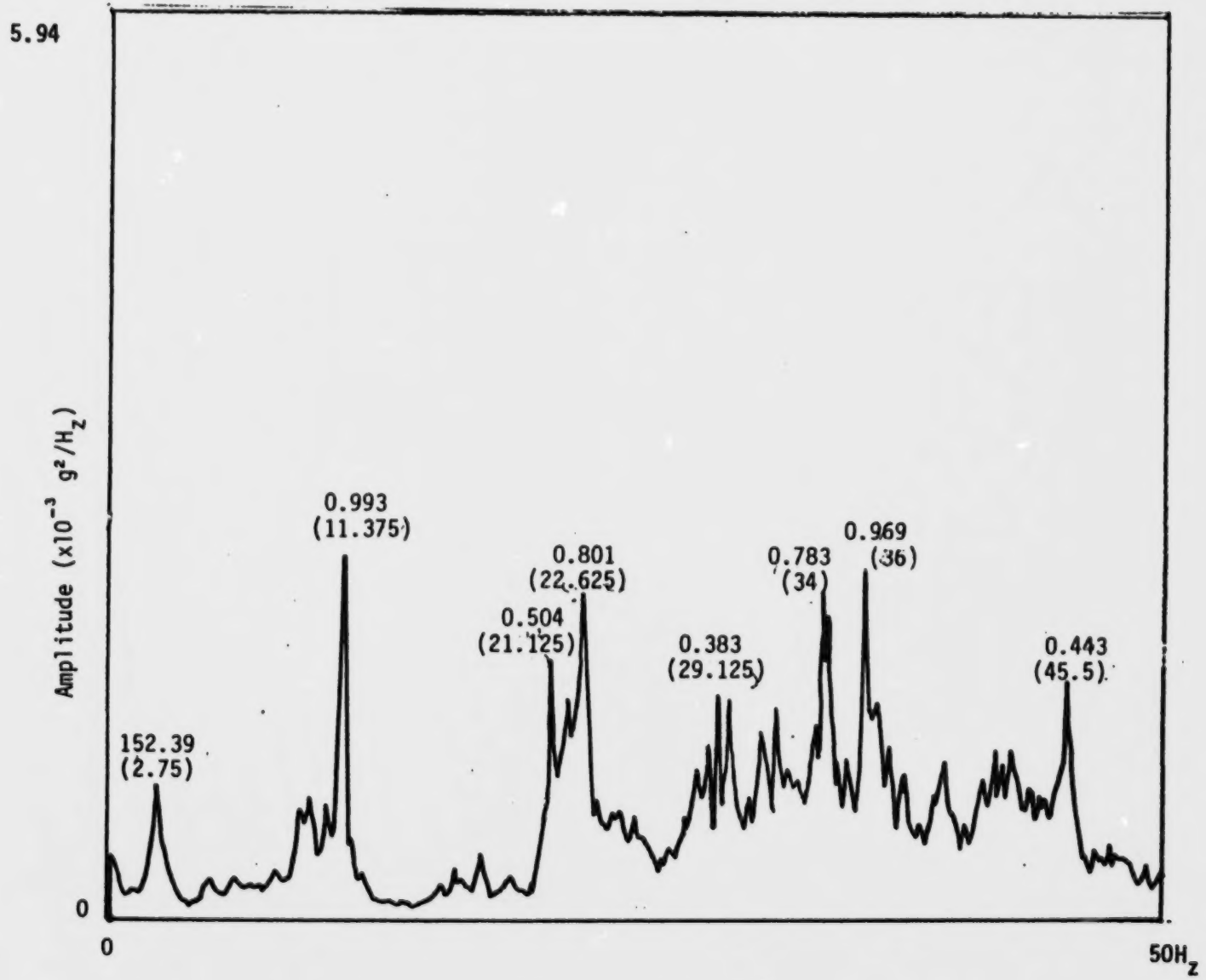


FIGURE 6.11a PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 5.33 Kts Ice: max.4' avg.3')
Vessel : USCGC POLAR SEA Test Time : 81:02:09:06:09
Sensor : 'BOW SWAY' Calibration: 1.1940 (g'/v)
Frequency: .50 (Hz)

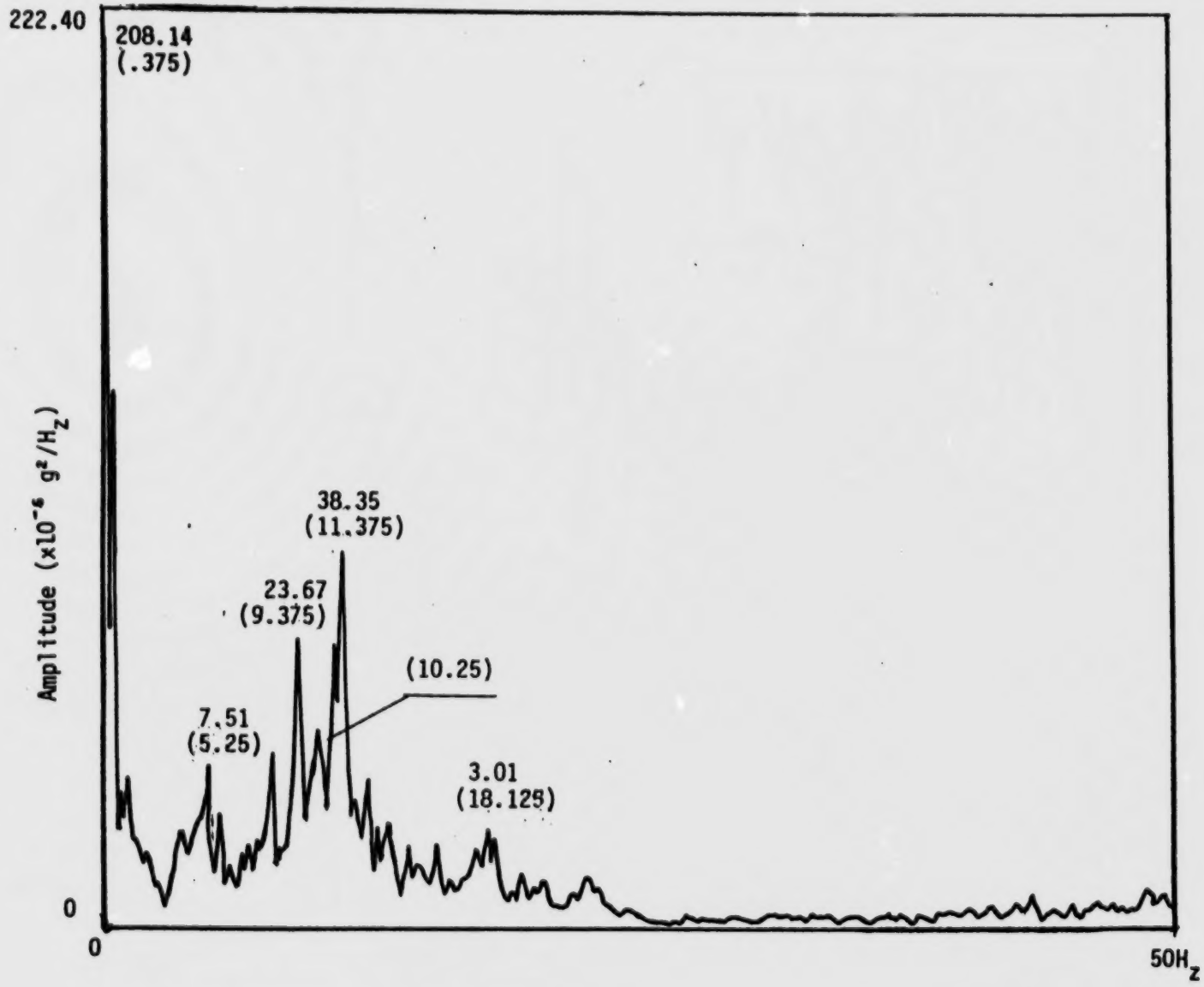


FIGURE 6.11b PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 5.33 Kts Ice: max.4′ avg.3′)
Vessel : USCGC POLAR SEA Test Time : 81:02:09:06:09
Sensor : 'BOW HEAVE' Calibration: 1.2500 (g′/v)
Frequency: 50 (Hz)

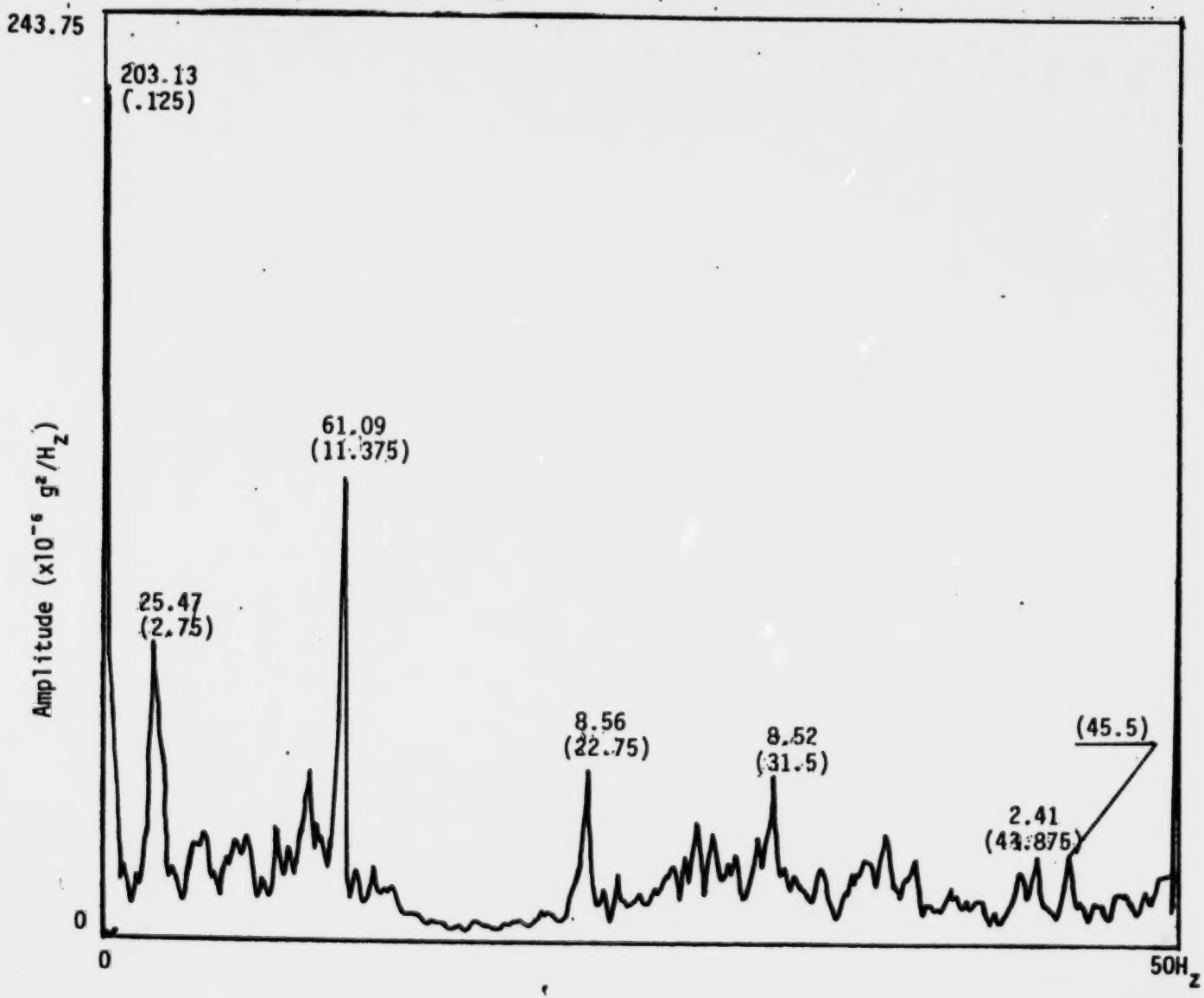


FIGURE 6.11c PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 5.33 Kts Ice: max.4' avg.3')
Vessel : USCGC POLAR SEA
Sensor : 'SURGE'
Frequency: 50 (Hz)
Test Time : 81:02:09:06:09
Calibration: .9591 (g'/v)

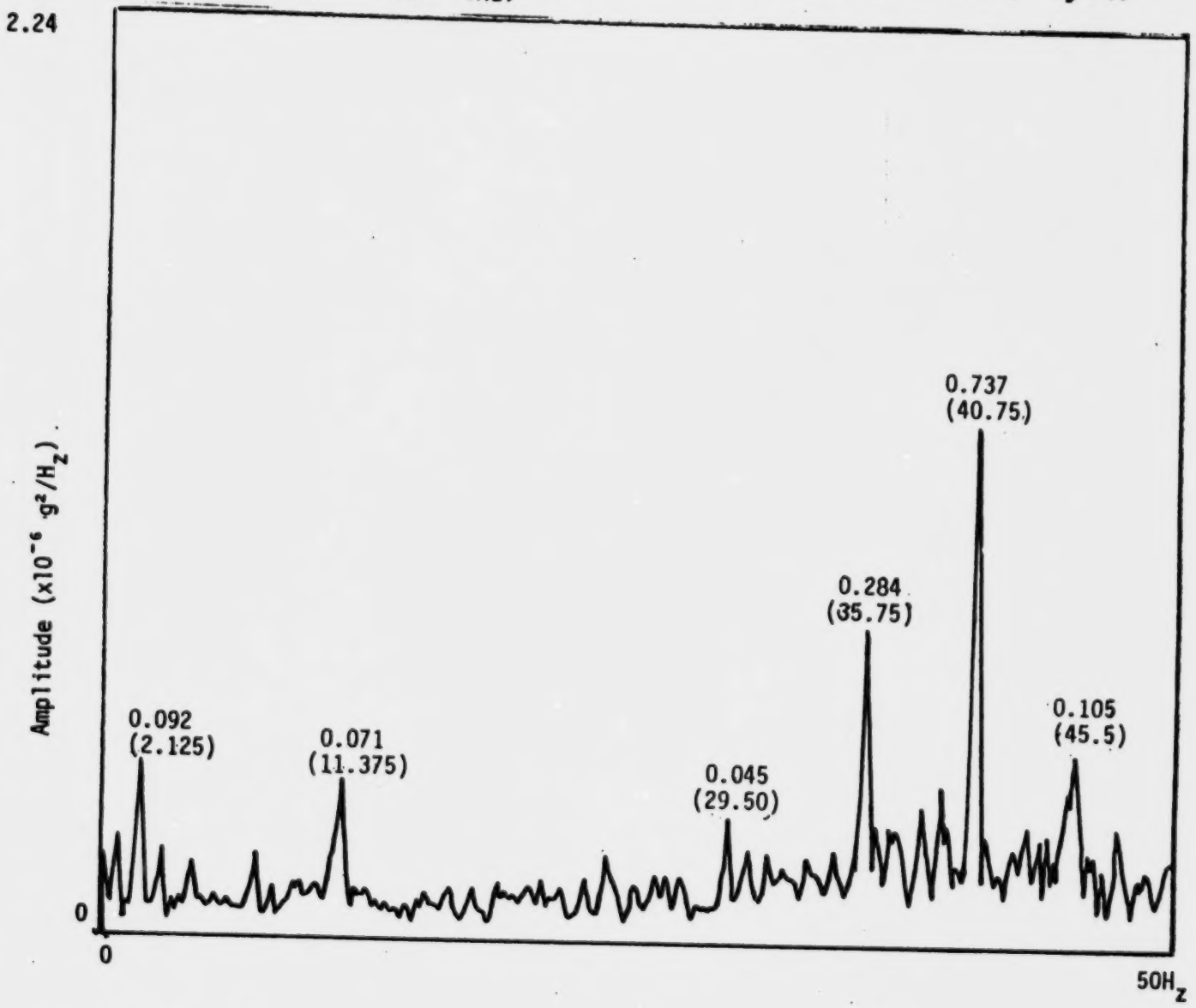


FIGURE 6.11d PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 5.33 Kts Ice: max.4′ avg.3′)
Vessel : USCGC POLAR SEA
Sensor : 'SWAY'
Frequency: 50 (Hz)
Test Time : 81:02:09:06:09
Calibration: .9547 (g'/v)

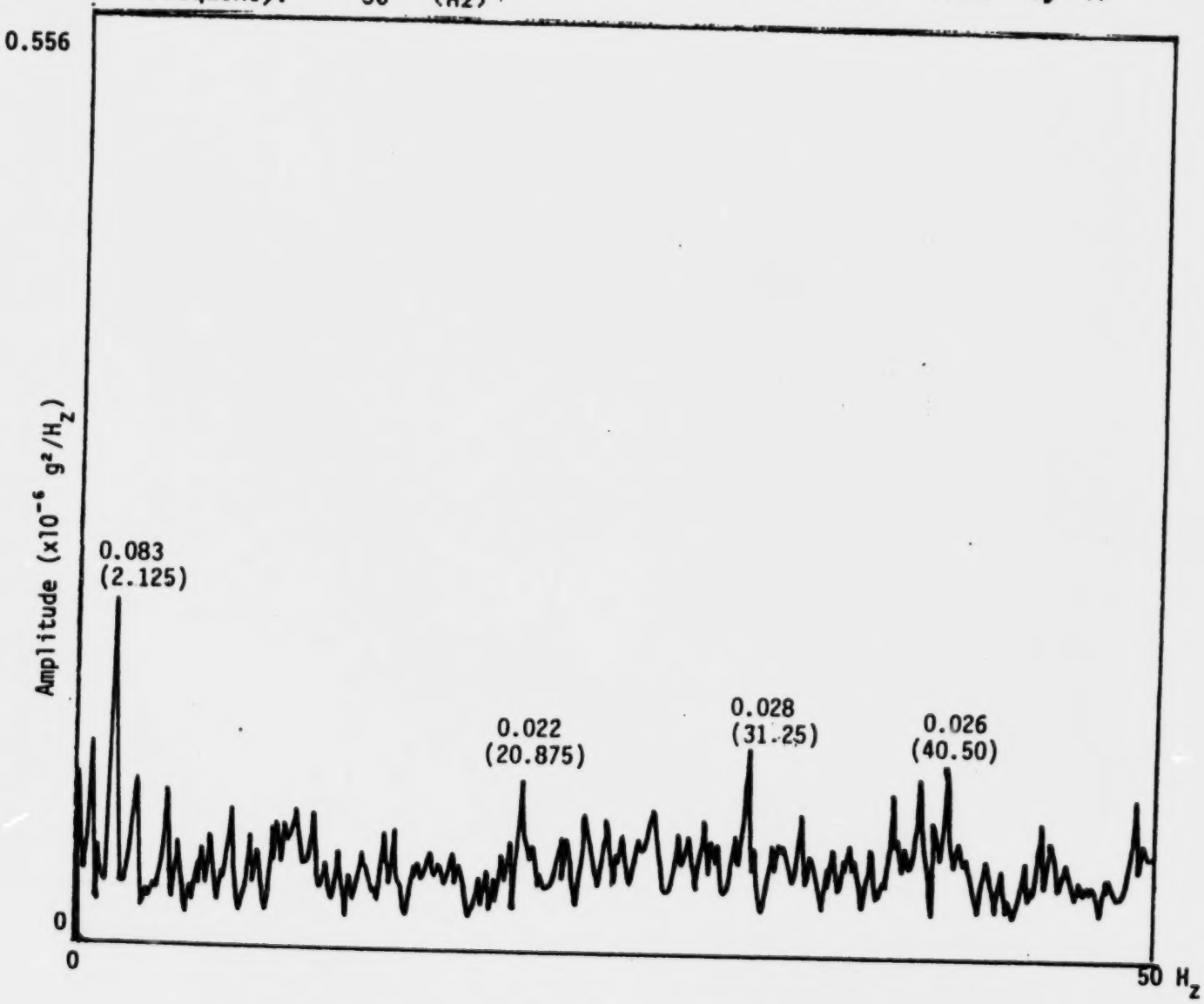


FIGURE 6.11e PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 5.33 Kts Ice: max.4' avg.3')
Vessel : USCGC POLAR SEA Test Time : 81:02:09:06:09
Sensor : 'HEAVE' Calibration: .9603 (g'/v)
Frequency: 50 (Hz)

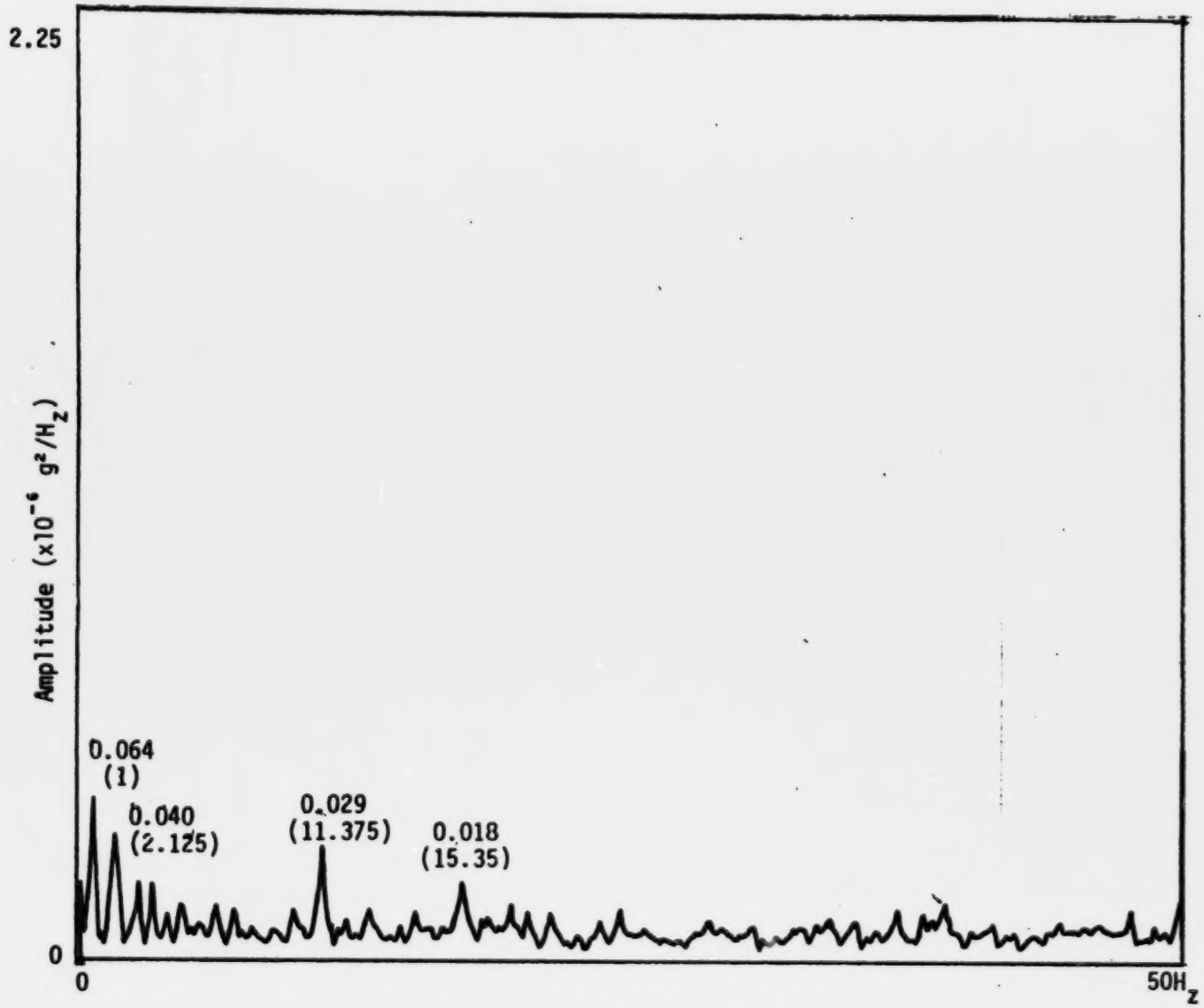


FIGURE 6.11f PEAK AVERAGE ACCELERATION SPECTRUM

Event : RAMMING IN LEVEL ICE (Head-on 5.33 Kts Ice: max.4' avg.3')
Vessel : USCGC POLAR SEA
Sensor : 'AFT SURGE'
Frequency: 50 (Hz)
Test Time : 81:02:09:06:09
Calibration: 1.1834 (g'/v)

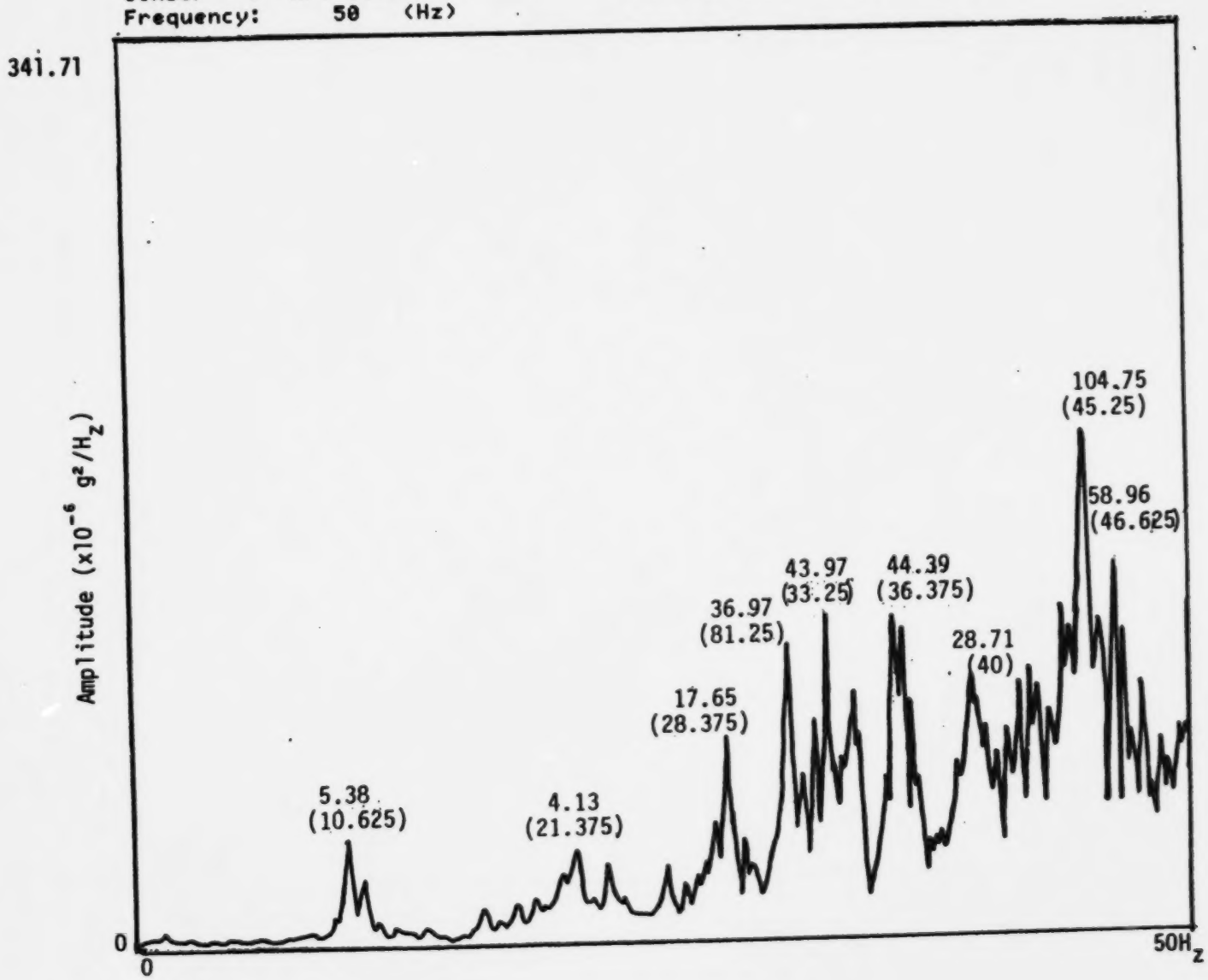


FIGURE 6.11g PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 5.33 Kts Ice: max.4′ avg.3′)
Vessel : USCGC POLAR SEA
Sensor : 'AFT SWAY'
Frequency: 50 (Hz)
Test Time : 81:02:09:06:09
Calibration: 1.2270 (g′/v)

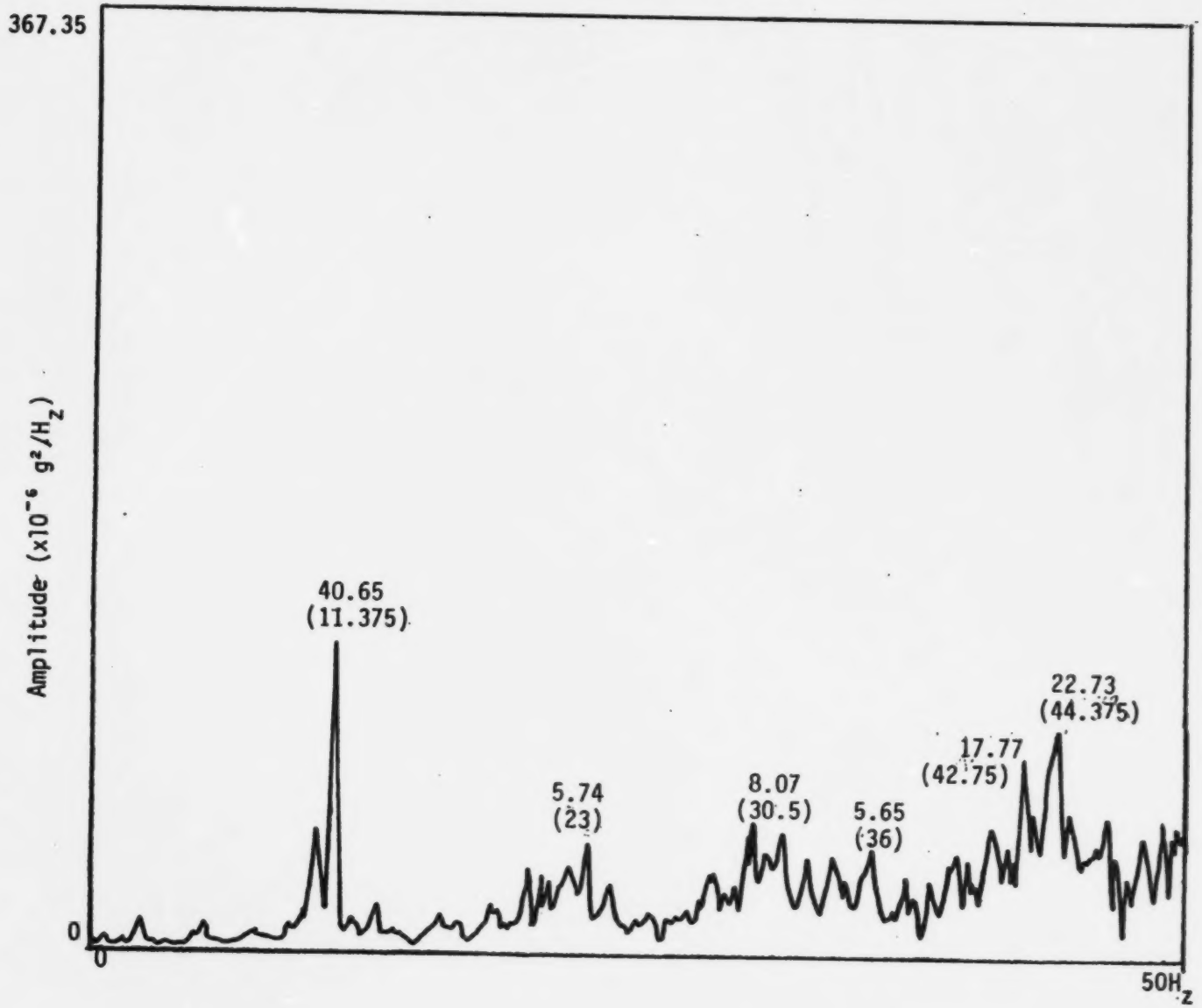


FIGURE 6.11h PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 5.33 Kts Ice: max.4' avg.3')
Vessel : USCGC POLAR SEA
Sensor : 'AFT HEAVE'
Frequency: 50 (Hz)
Test Time : 81:02:09:06:09
Calibration: 1.2345 (g'/v)

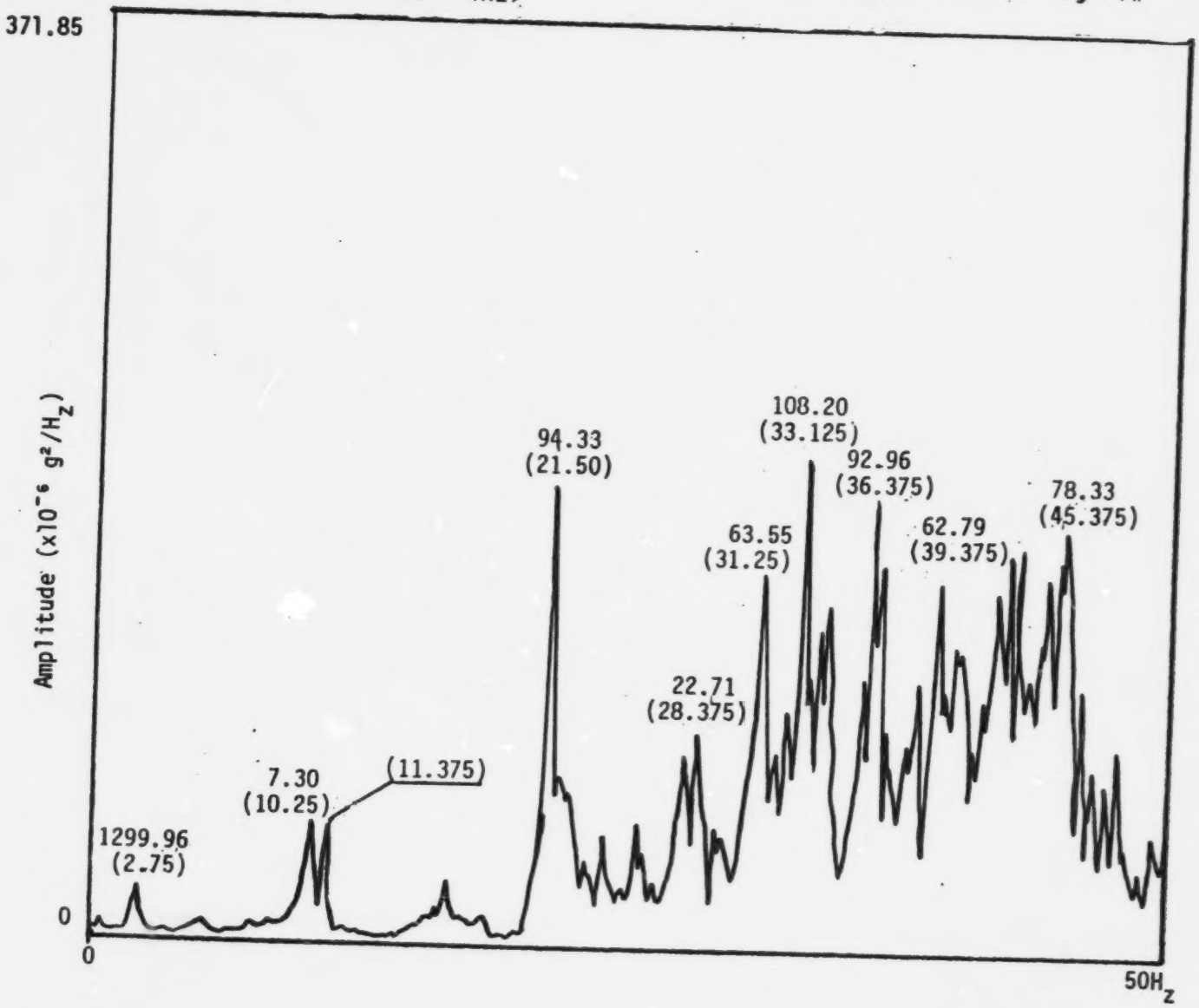


FIGURE 6.12a PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 4 Kts Ice: max.3' avg.2')
Vessel : USCGC POLAR SEA Test Time : 81:02:09:14:00
Sensor : 'BOW SWAY' Calibration: 1.1940 (g'/v)
Frequency: 50 (Hz)

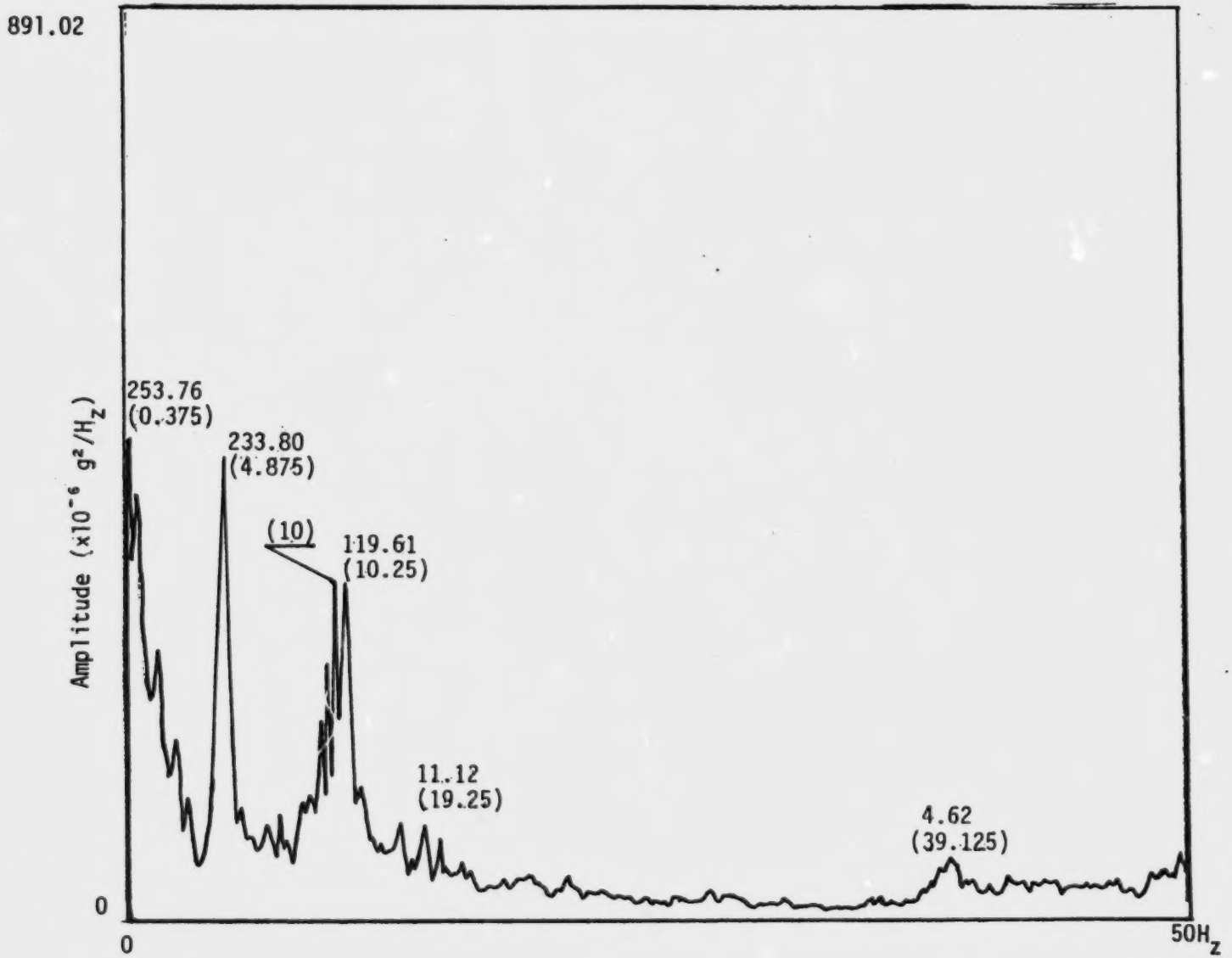


FIGURE 6.12b PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 4 Kts Ice: max.3′ avg.2′)
Vessel : USCGC POLAR SEA
Sensor : ′BOW HEAVE′
Frequency: 50 (Hz)
Test Time : 81:02:09:14:00
Calibration: 1.2500 (g′/v)

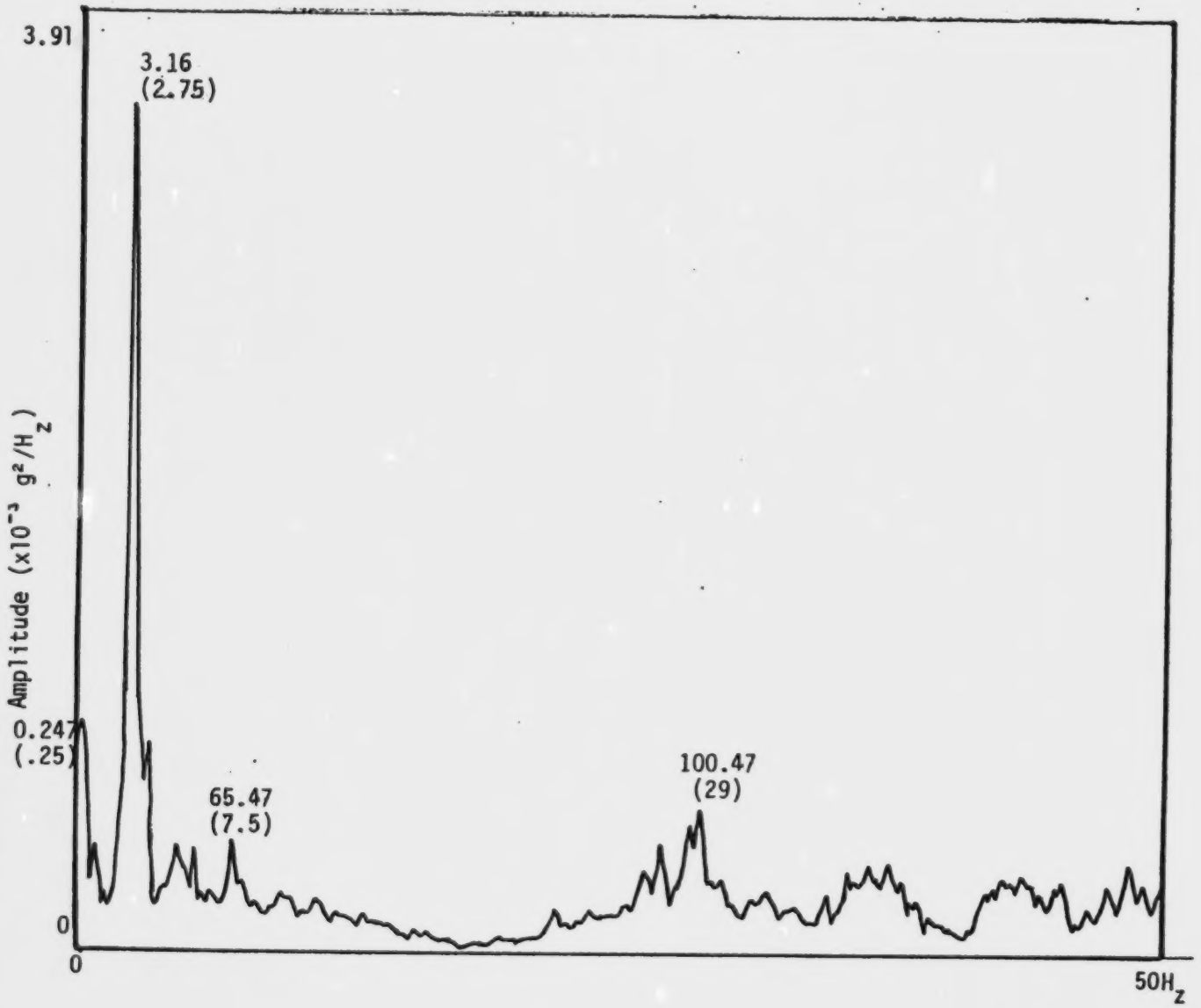


FIGURE 6.12c PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 4 Kts Ice: max.3′ avg.2′)
Vessel : USCGC POLAR SEA Test Time : 81:02:09:14:00
Sensor : ′SURGE′ Calibration: .9591 (g′/v)
Frequency: 50 (Hz)

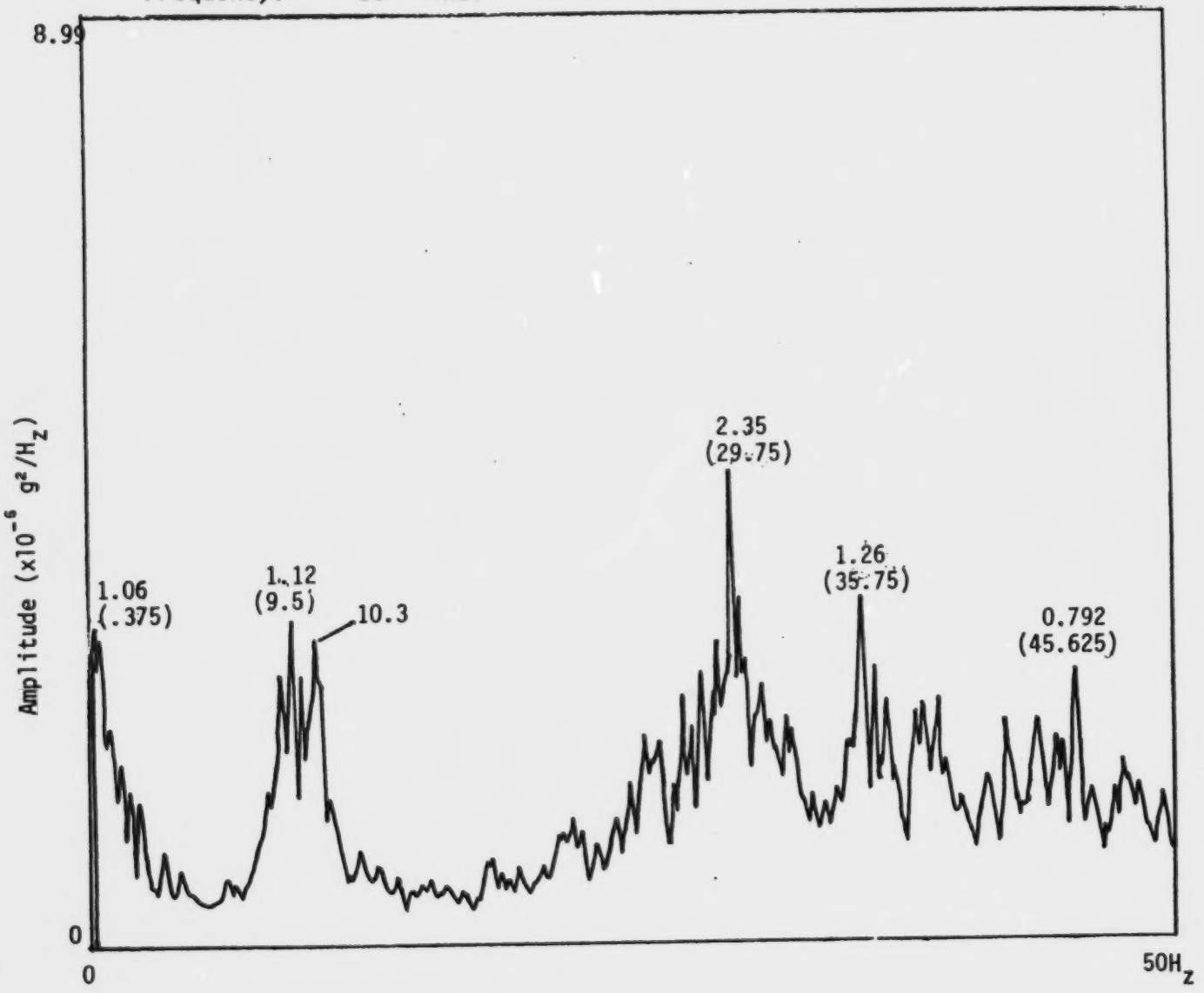


FIGURE 6.12d PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 4 Kts Ice: max.3′ avg.2′)
Vessel : USCGC POLAR SEA Test Time : 81:02:09:14:00
Sensor : 'SWAY' Calibration: .9547 (g′/v)
Frequency: 50 (Hz)

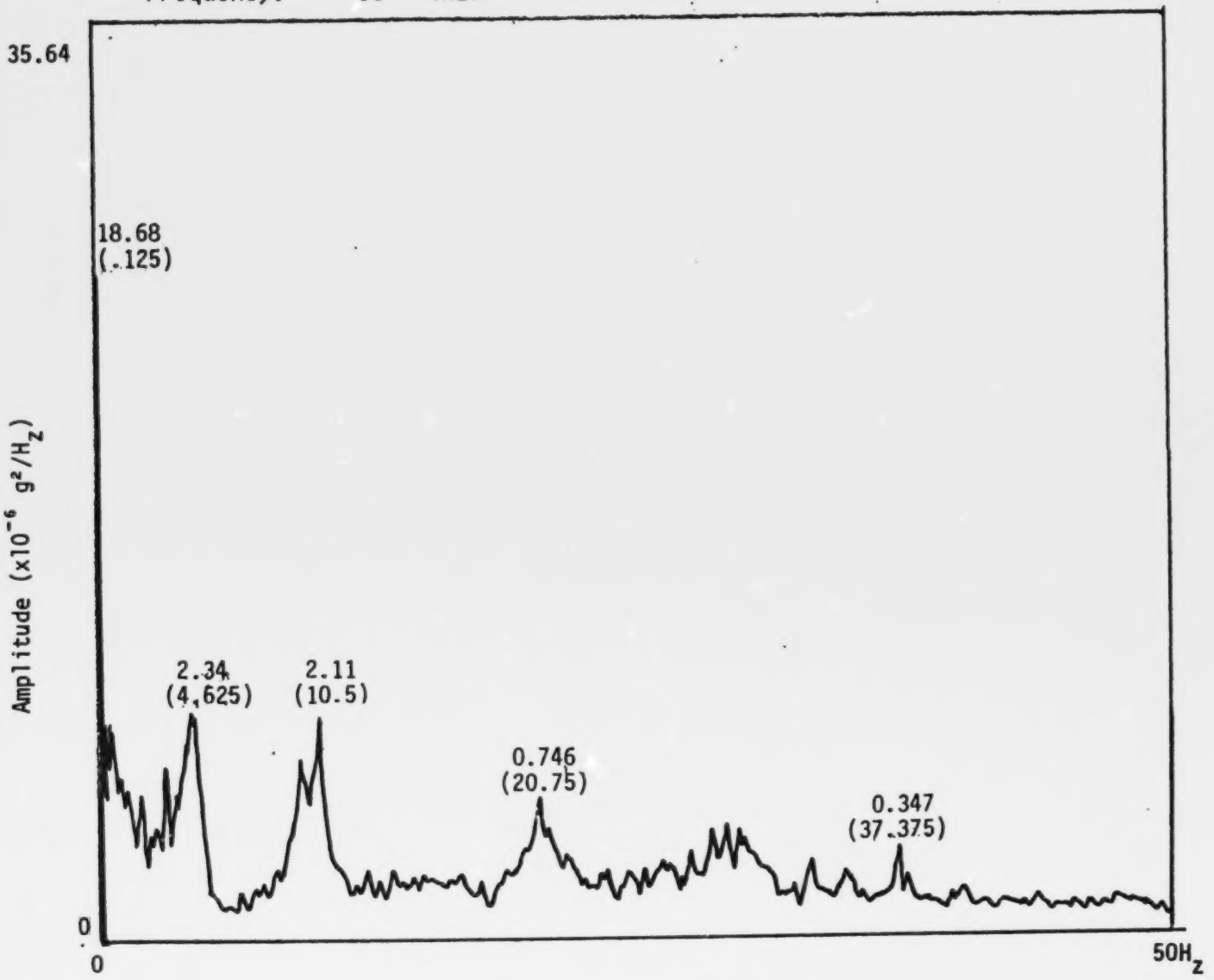


FIGURE 6.12e PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 4 Kts Ice: max.3′ avg.2′)
Vessel : USCGC POLAR SEA Test Time : 81:02:09:14:00
Sensor : 'HEAVE' Calibration: .9603 (g′/v)
Frequency: 50 (Hz)

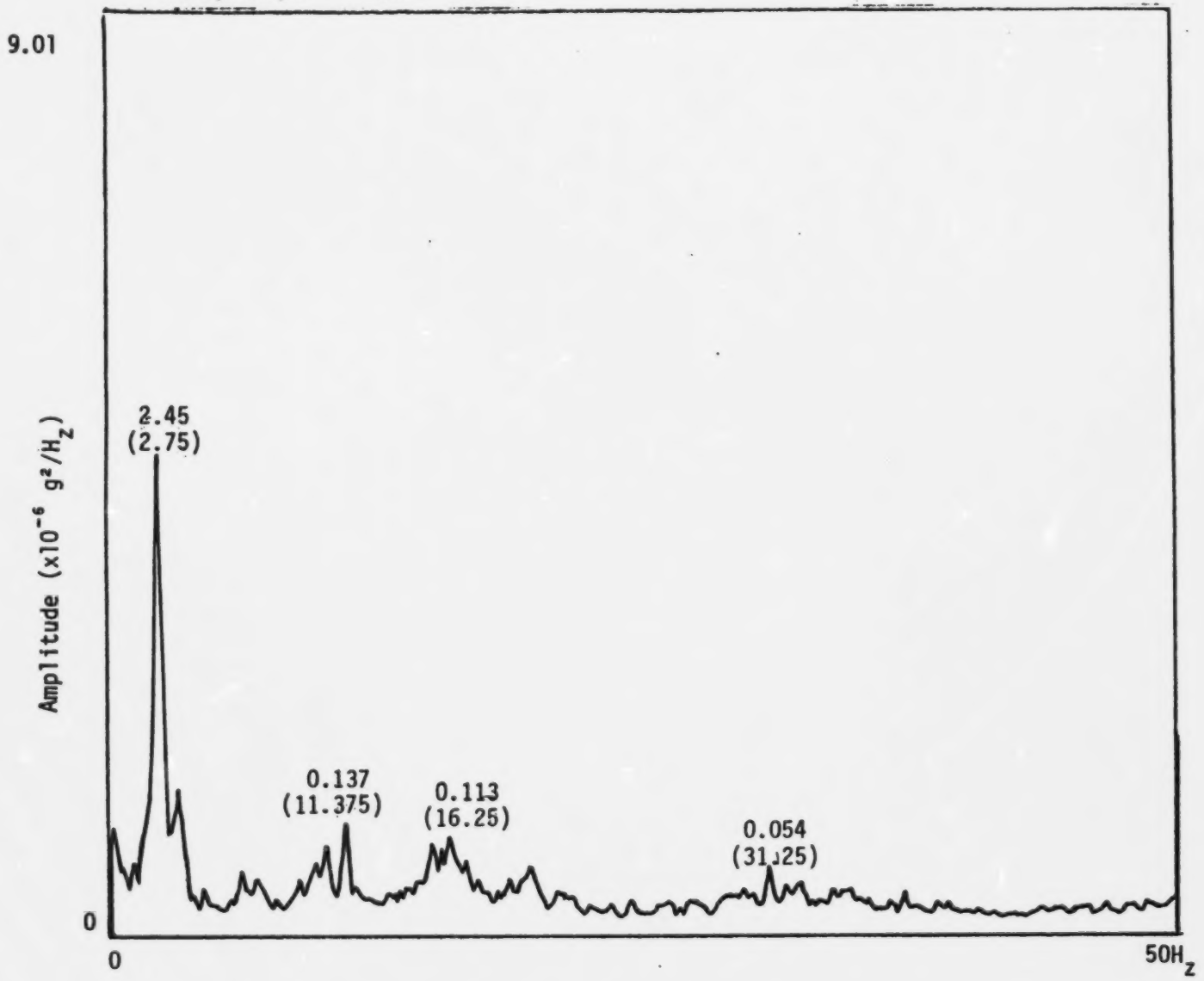


FIGURE 6.12f PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 4 Kts Ice: max.3' avg.2')
Vessel : USCGC POLAR SEA Test Time : 81:02:09:14:00
Sensor : 'AFT SURGE' Calibration: 1.1834 (g'/v)
Frequency: 50 (Hz)

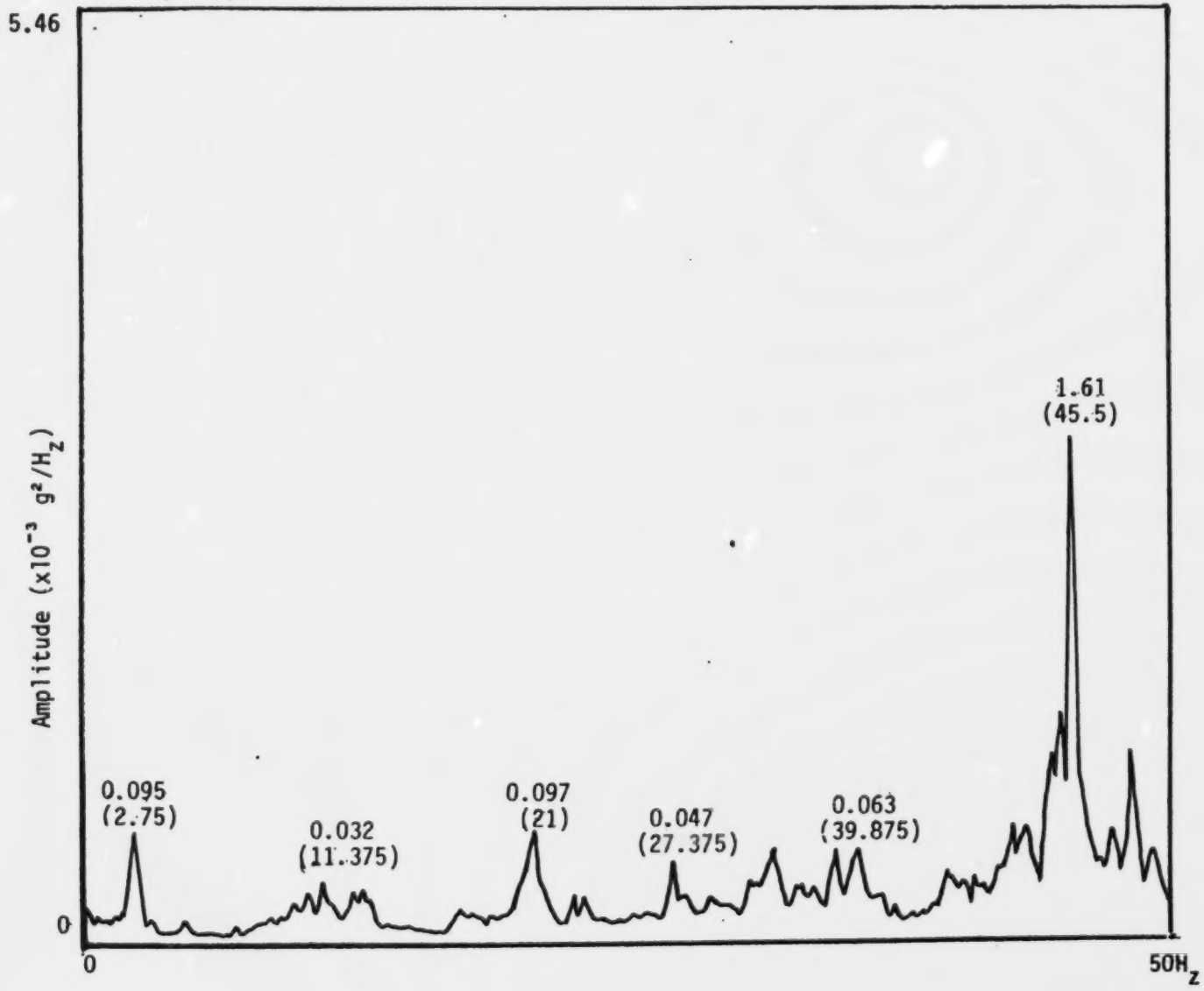


FIGURE 6.12g PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 4 Kts Ice: max.3′ avg.2′)
Vessel : USCGC POLAR SEA Test Time : 81:02:09:14:00
Sensor : 50 AFT SWAY Calibration: 1.2270 (g′/v)
Frequency: 50 (Hz)

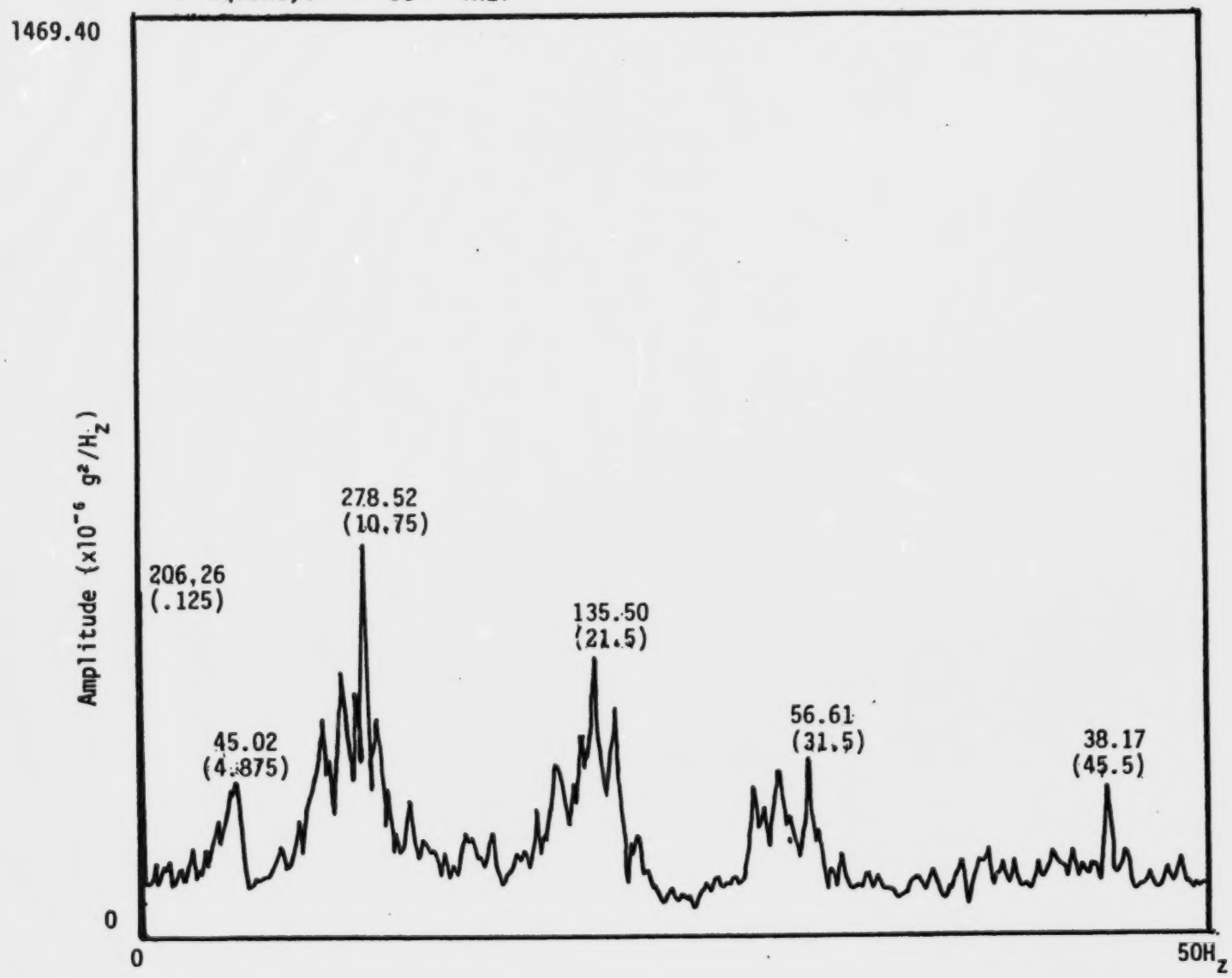


FIGURE 6.12h PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING IN LEVEL ICE (Head-on 4 Kts Ice: max.3' avg.2')
Vessel : USCGC POLAR SEA
Sensor : 'AFT HEAVE'
Frequency: 50 (Hz)
Test Time : 81:02:09:14:00
Calibration: 1.2345 (g'/v)

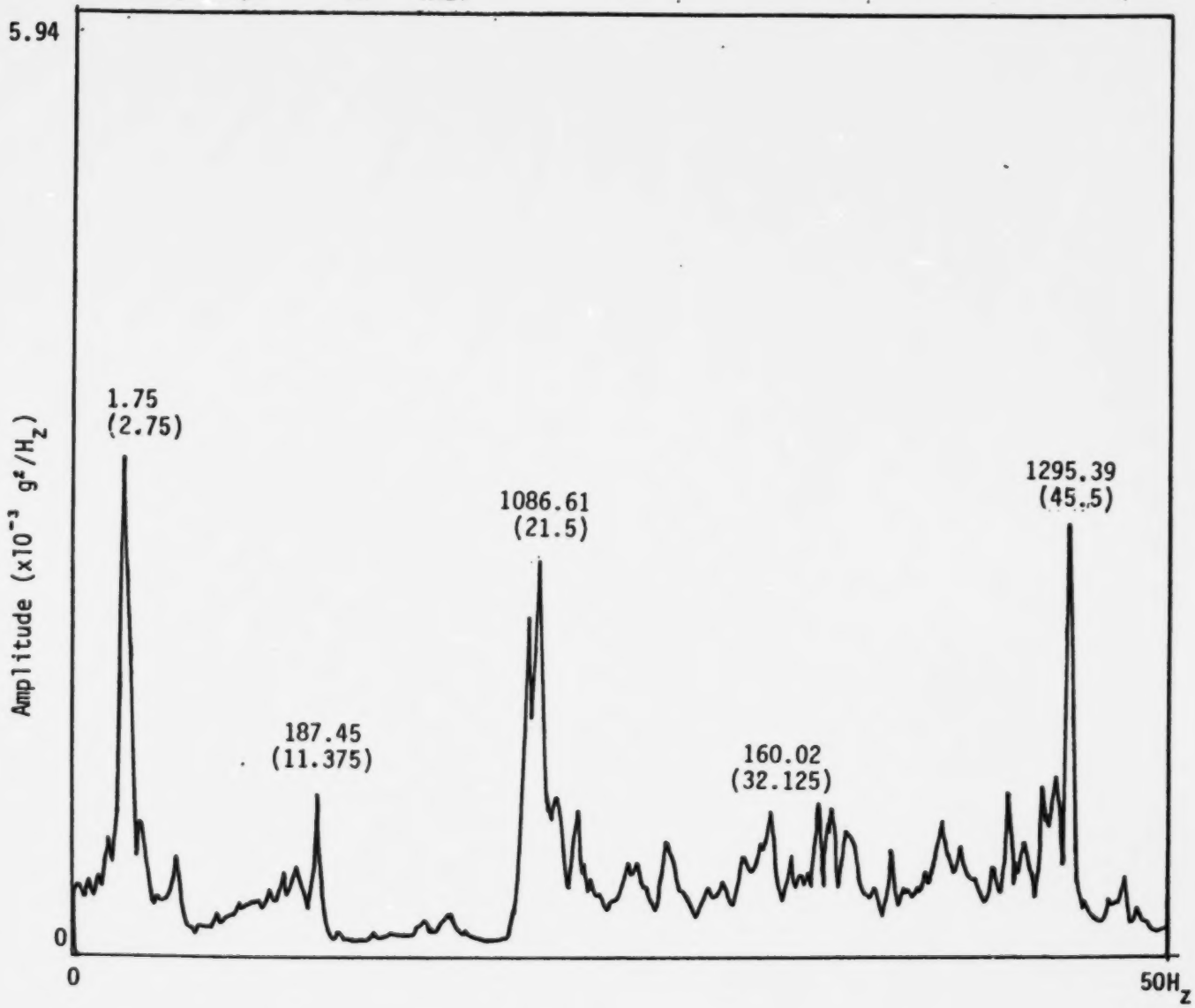


FIGURE 6.13a PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4' avg.3.5')
Vessel : USCGC POLAR SEA
Sensor : 'BOW HEAVE'
Frequency: 500 (Hz)
Test Time : 81:02:08:02:30
Calibration: 1.2500 (g'/v)

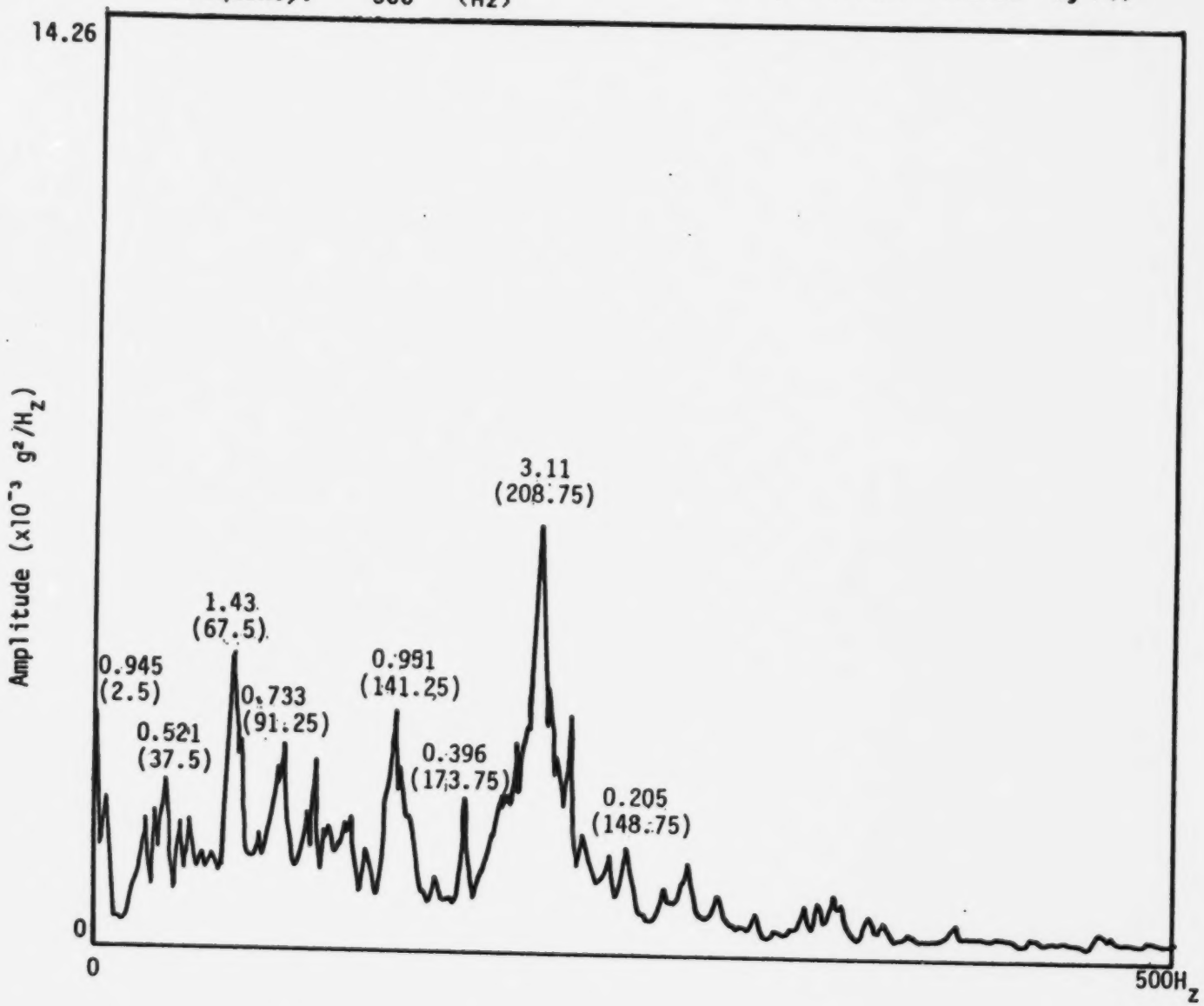


FIGURE 6.13b PEAK AVERAGE ACCELERATION SPECTRUM

Event : RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4' avg.3.5')
Vessel : USCGC POLAR SEA
Sensor : 'BOW SWAY'
Frequency: 500 (Hz)
Test Time : 81:02:08:02:30
Calibration: 1.1940 (g'/v)

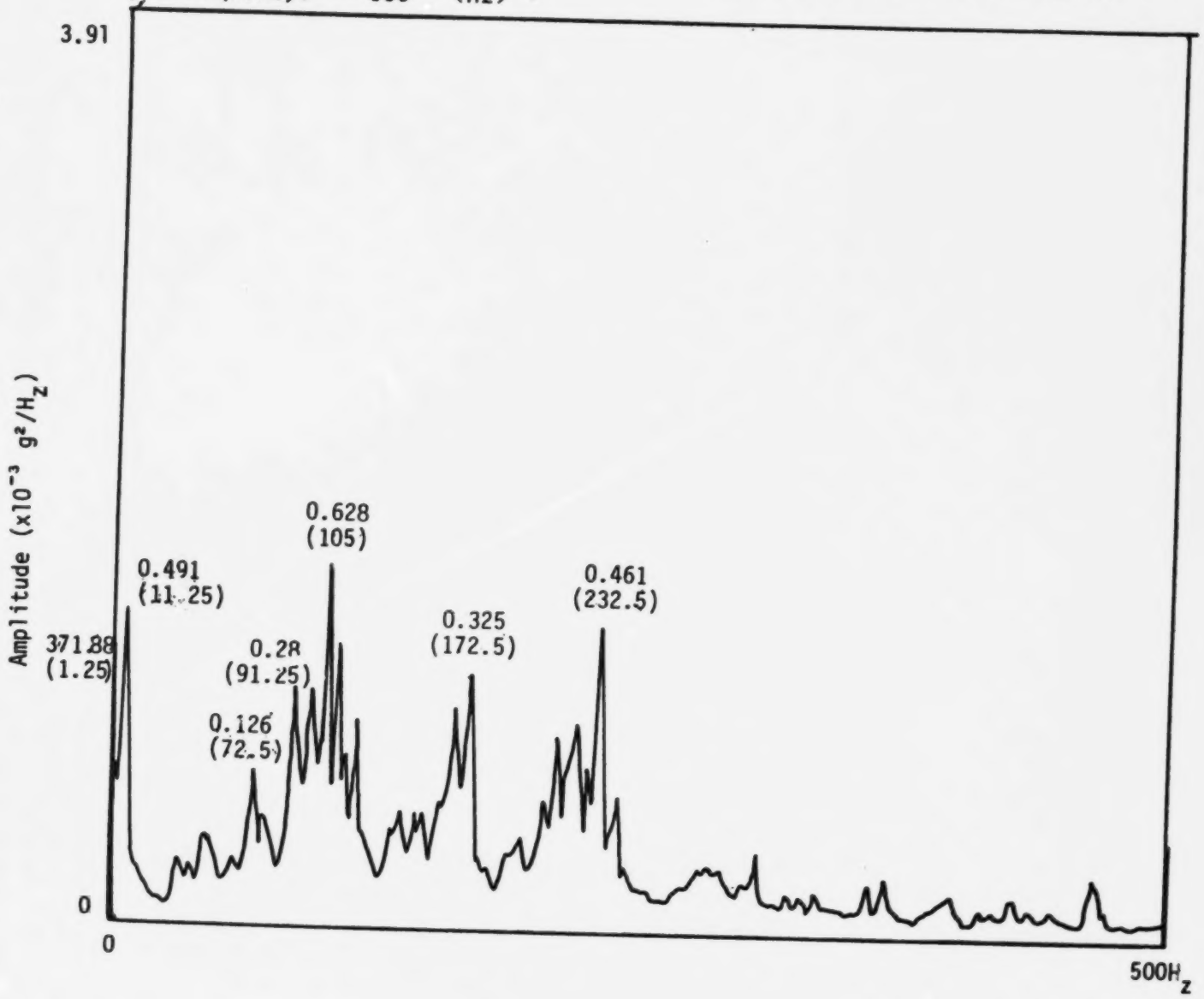


FIGURE 6.13c PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4′ avg.3.5′)
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : 'SURGE' Calibration: .9591 (g′/v)
Frequency: 500 (Hz)

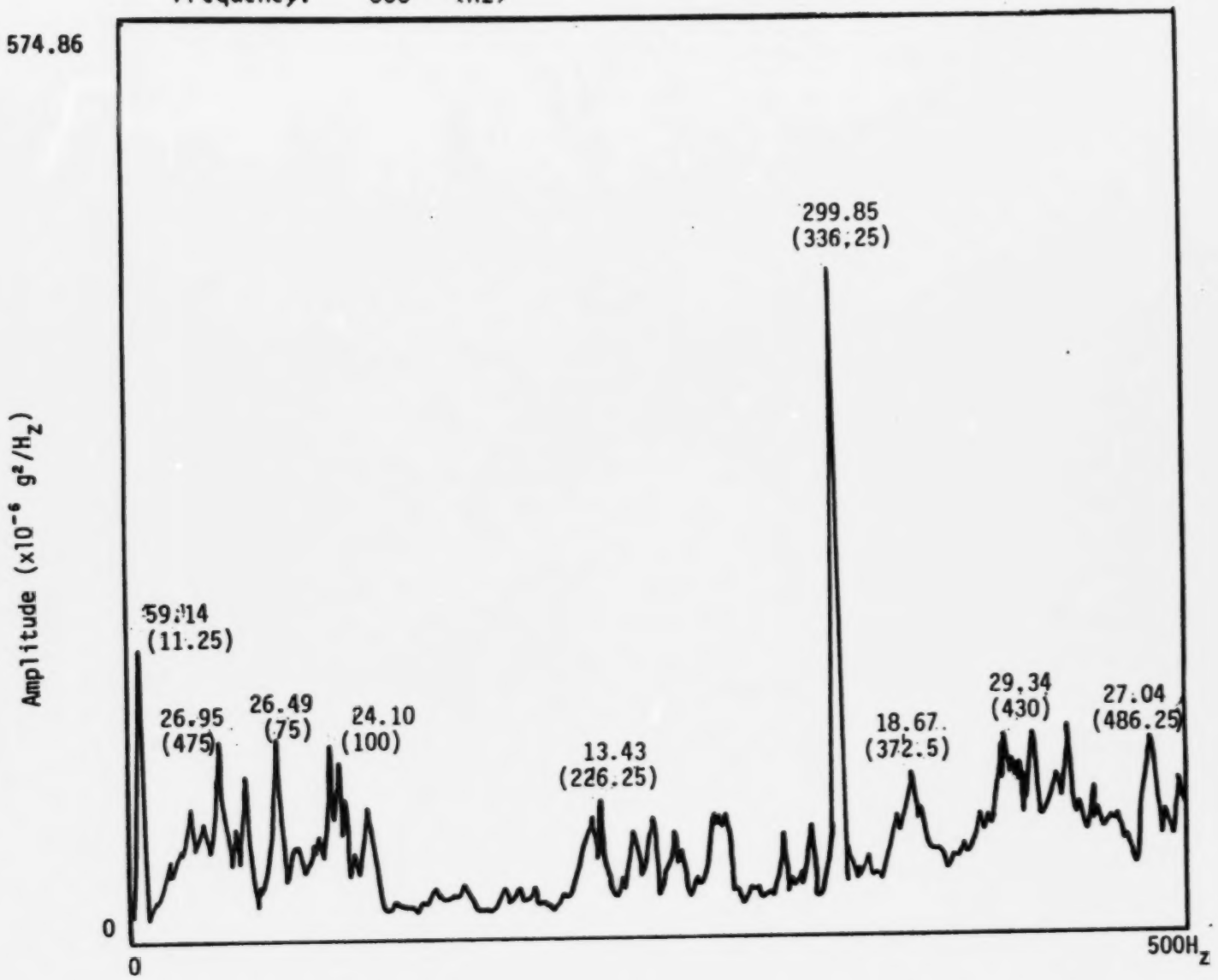


FIGURE 6.13d PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4′ avg.3.5′)
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : 'SWAY' Calibration: .9547 (g′/v)
Frequency: 500 (Hz)

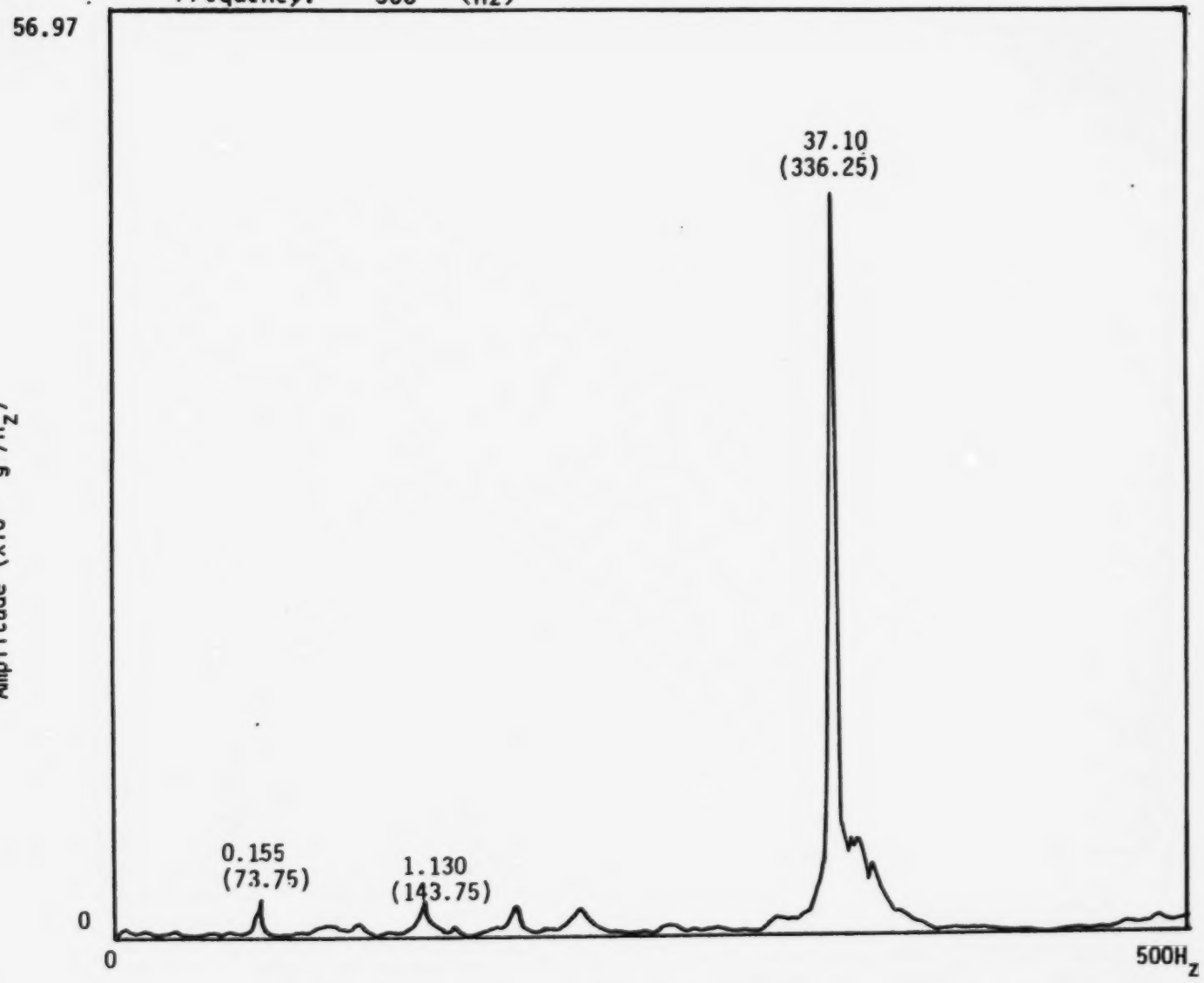


FIGURE 6.13e PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4′ avg.3.5′)
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : 'HEAVE' Calibration: .9603 (g′/v)
Frequency: 500 (Hz)

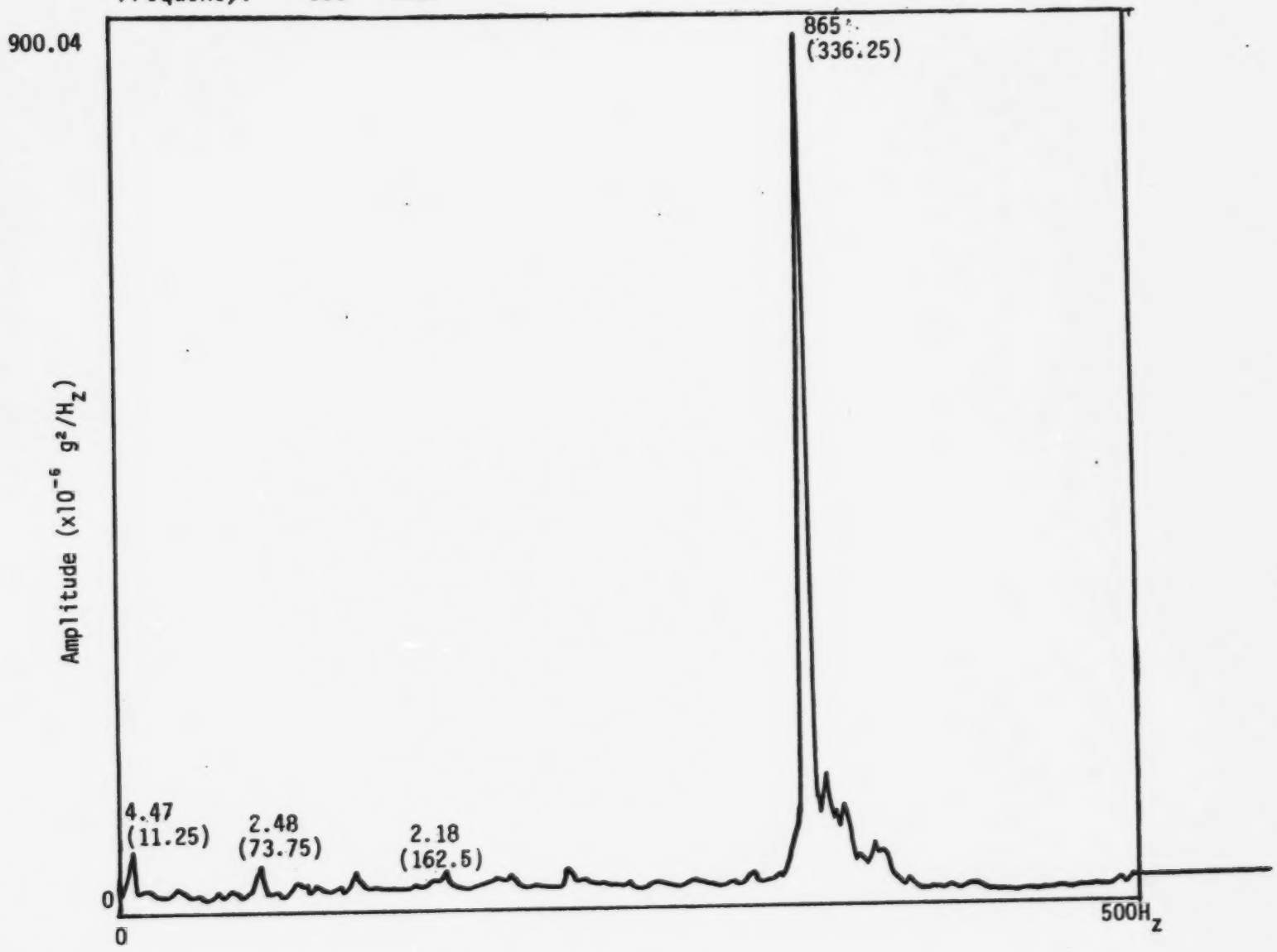


FIGURE 6.13f PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4′ avg.3.5′)
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : ′AFT SURGE′ Calibration: 1.1034 (g′/v)
Frequency: 500 (Hz)

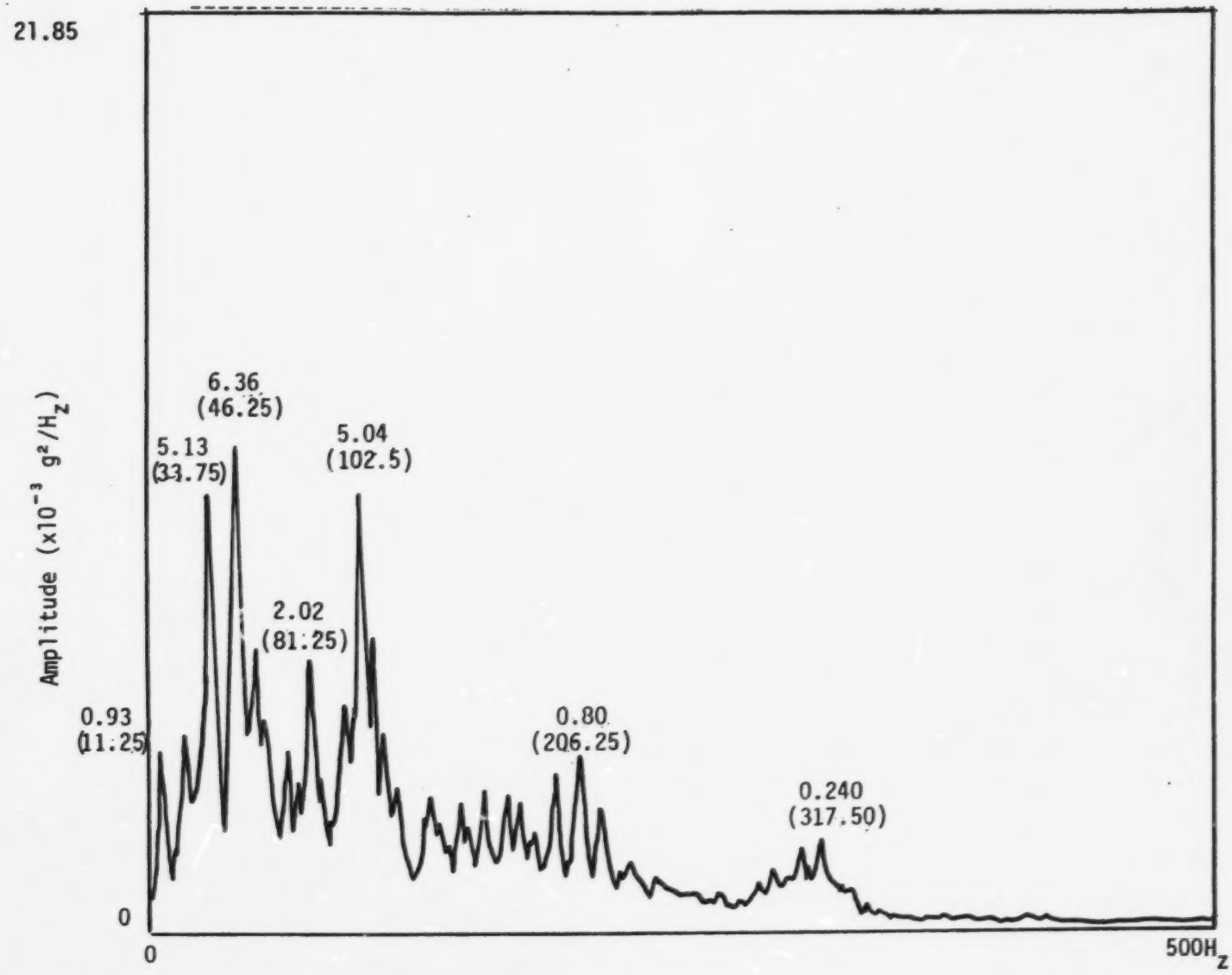


FIGURE 6.13g PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4' avg.3.5')
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : 'AFT HEAVE' Calibration: 1.2345 (g'/v)
Frequency: 500 (Hz)

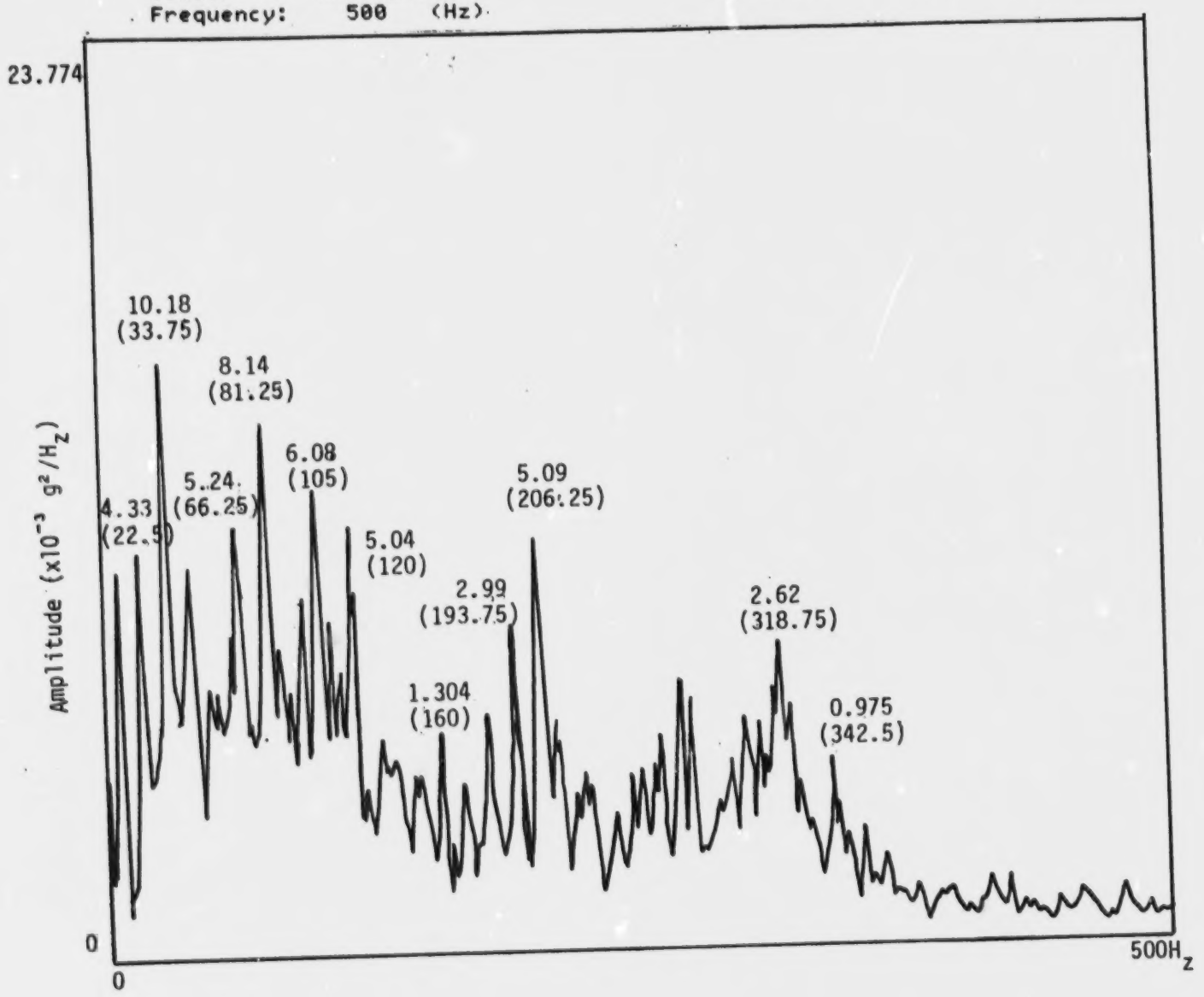


FIGURE 6.13h PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4′ avg.3.5′)
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : AFT SWAY′ Calibration: 1.2270 (g′/v)
Frequency: 500 (Hz)

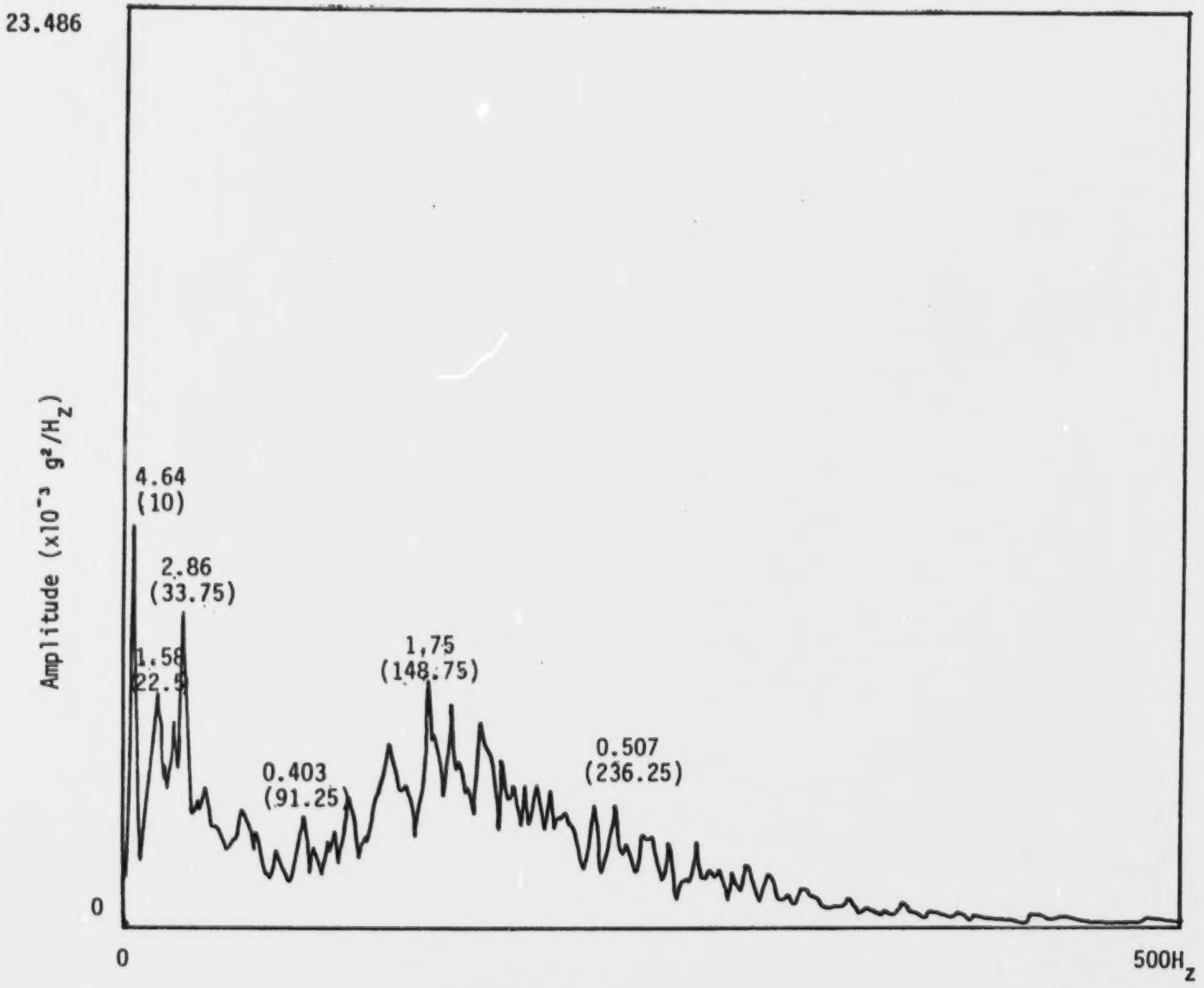


FIGURE 6.14a PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4' avg.3.5')
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : 'BOW SWAY' Calibration: 1.1940 (g'/v)
Frequency: 50 (Hz)

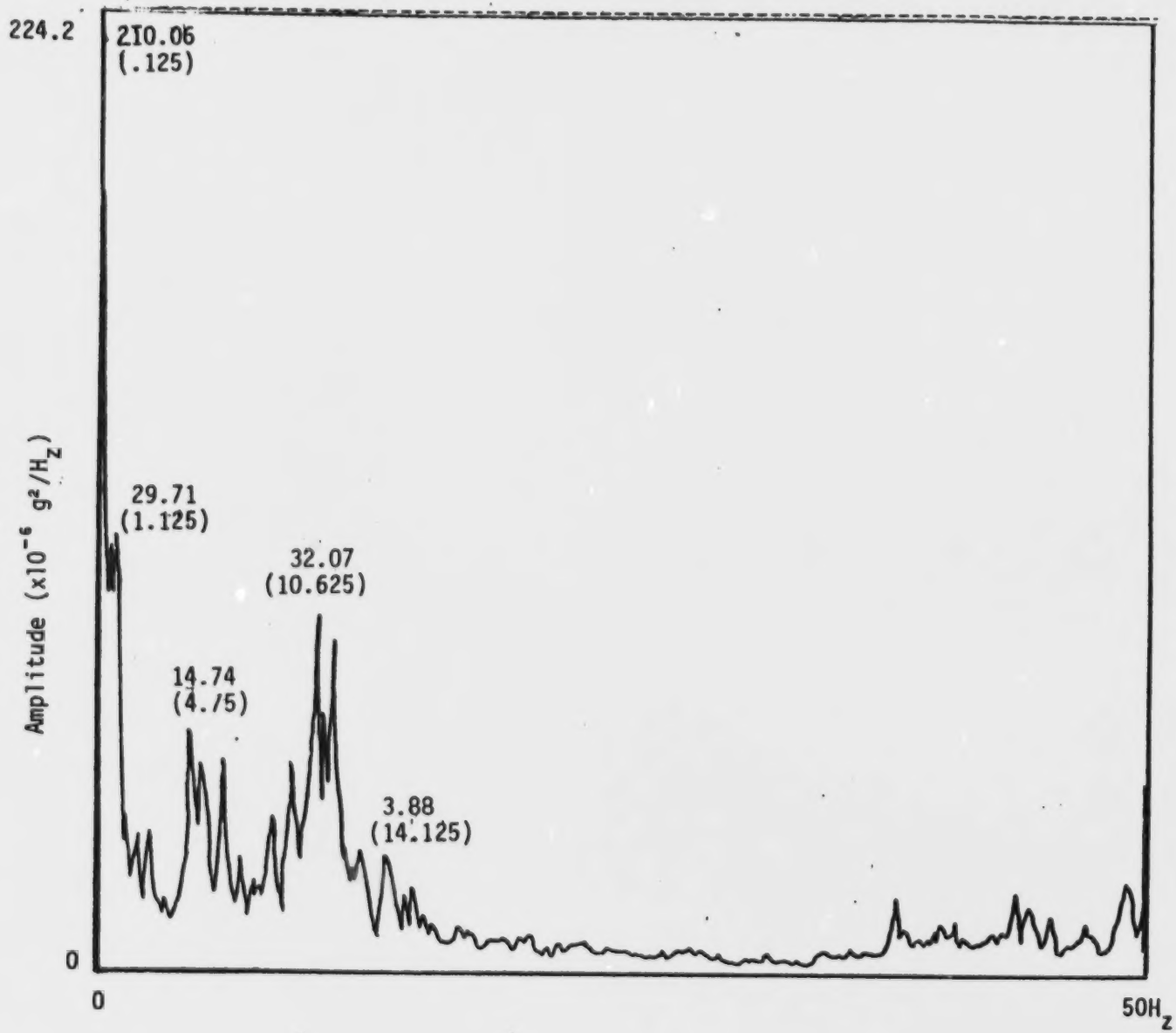


FIGURE 6.14b PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4' avg.3.5')
Vessel : USCGC POLAR SEA
Sensor : 'BOW HEAVE'
Frequency: 50 (Hz)
Test Time : 81:02:08:02:30
Calibration: 1.2500 (g'/v)

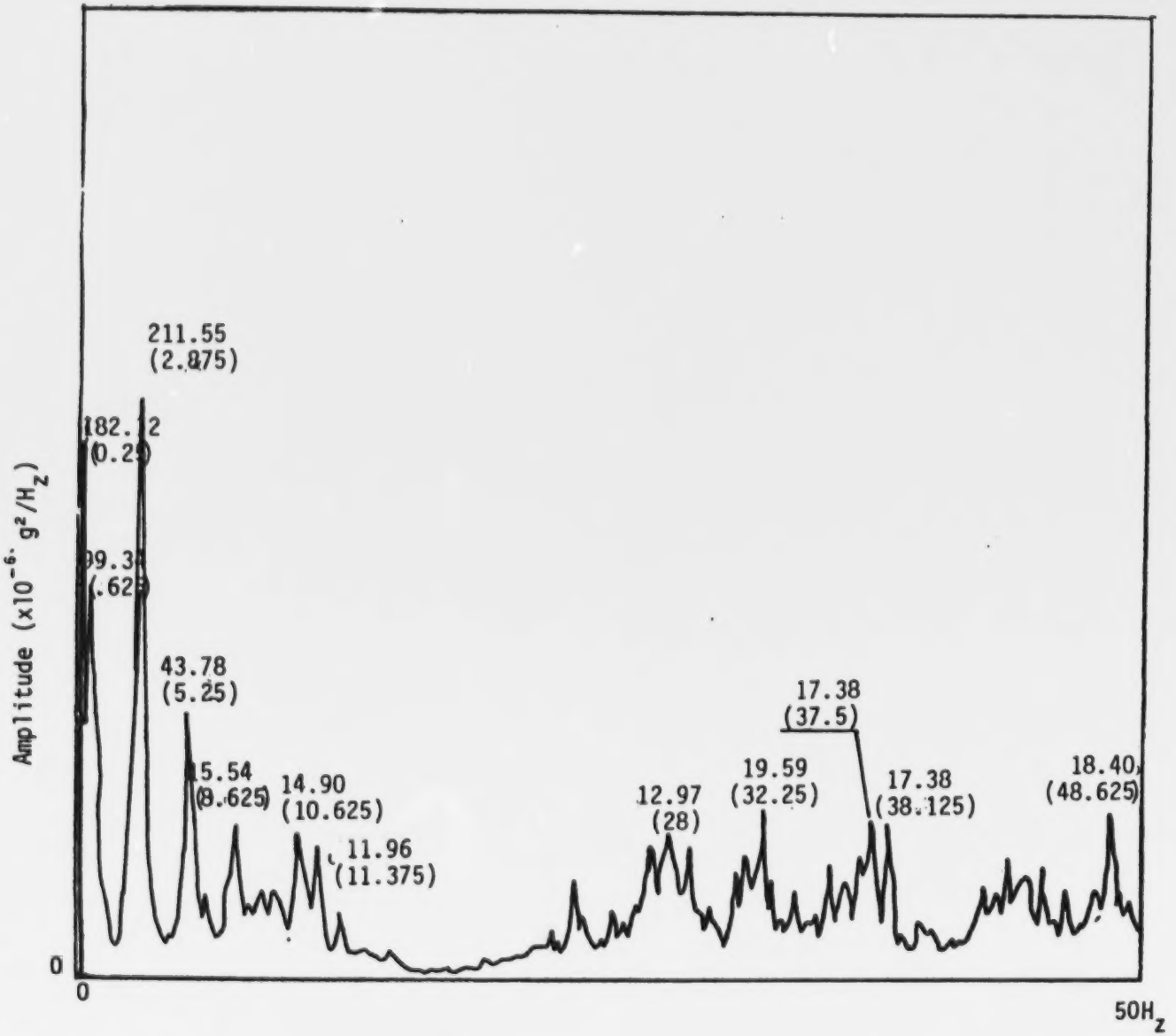


FIGURE 6.14c PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4′ avg.3.5′)
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : 'SURGE' Calibration: .9591 (g′/v)
Frequency: 50 (Hz)

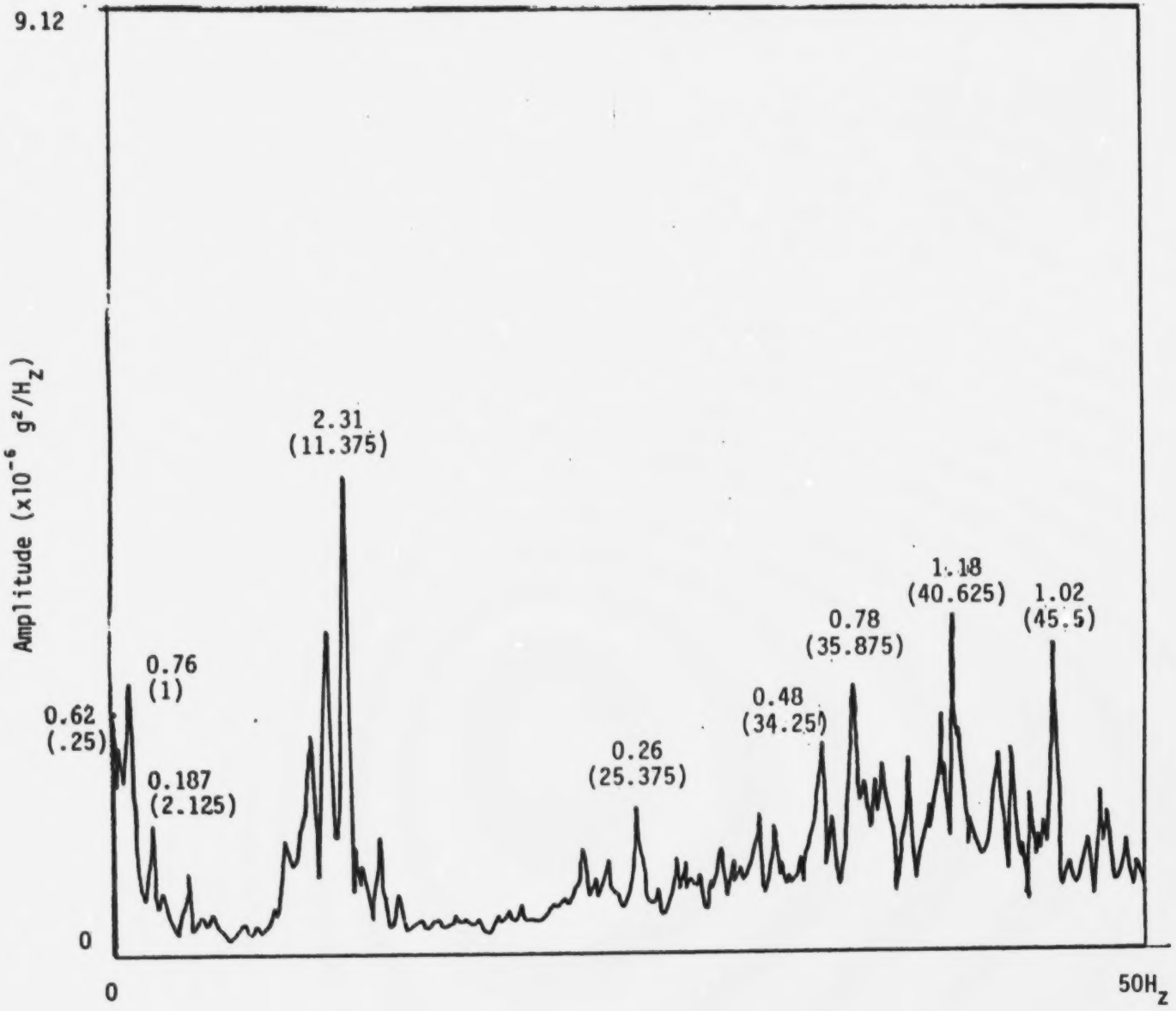


FIGURE 6.14d PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4′ avg.3.5′)
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : 'SWAY' Calibration: .9547 (g′/v)
Frequency: 50 (Hz)

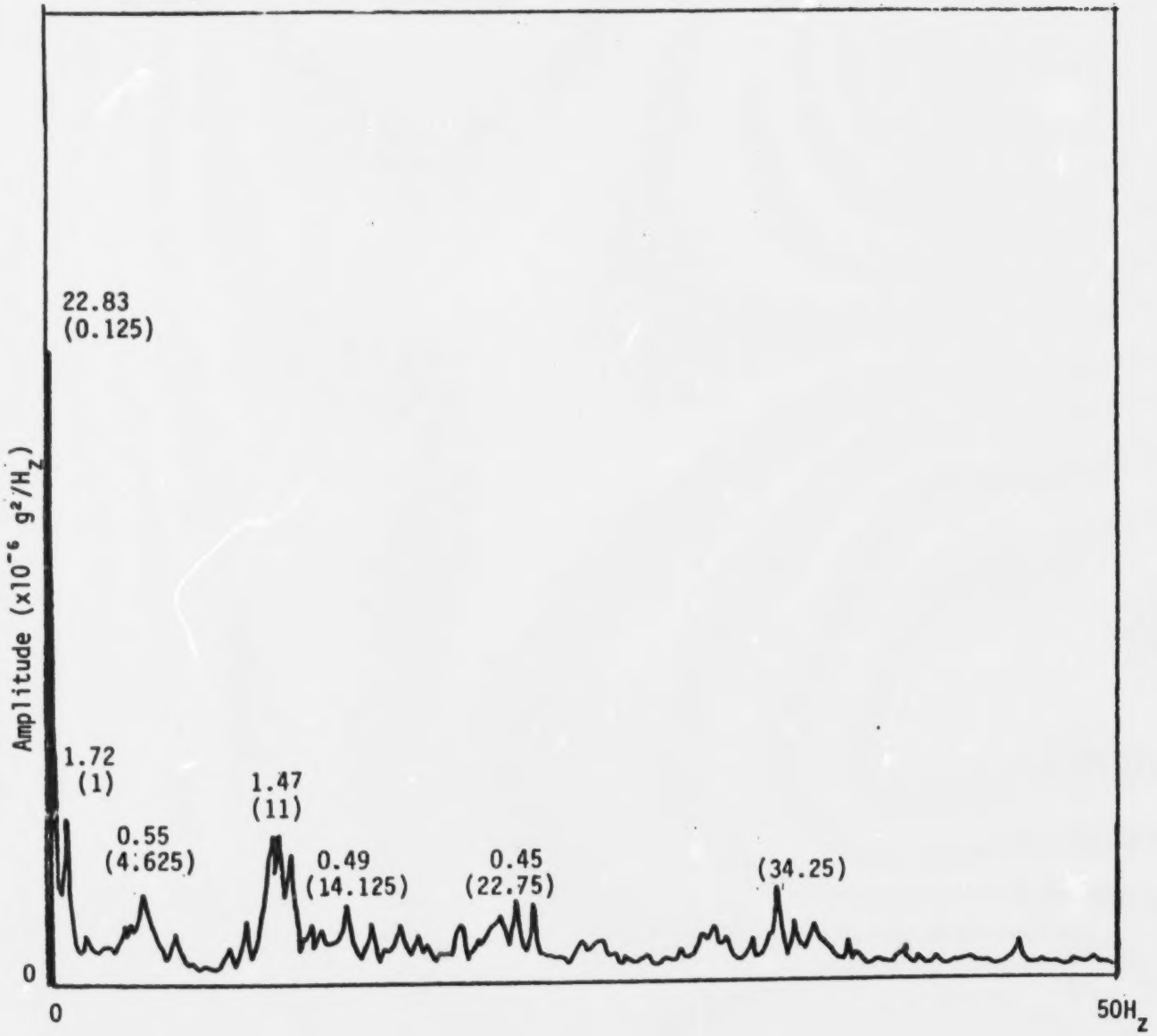


FIGURE 6.14e PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4′ avg.3.5′)
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : 'HEAVE' Calibration: .9603 (g′/v)
Frequency: 50 (Hz)

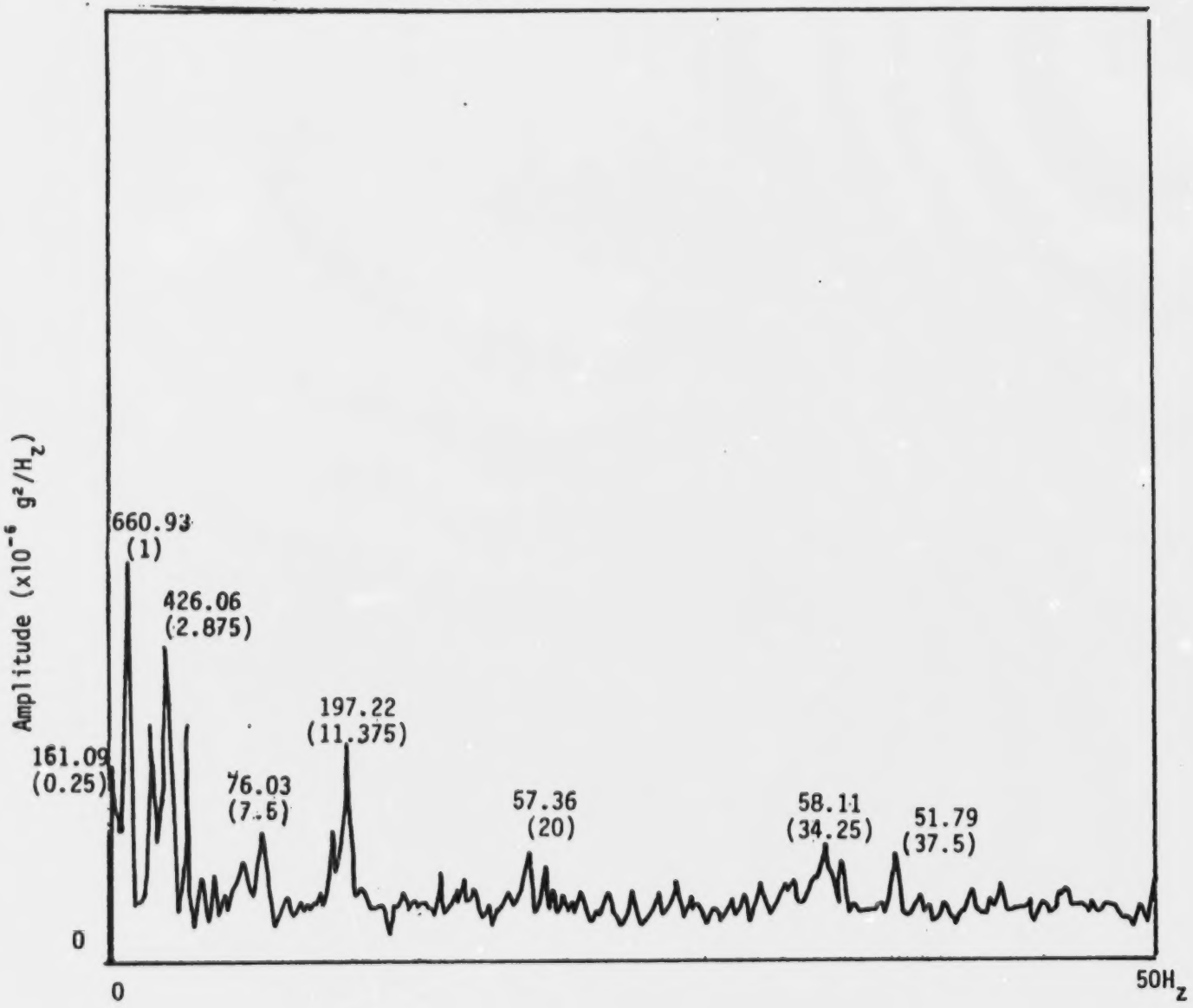


FIGURE 6.14f PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4' avg.3.5')
Vessel : USCGC POLAR SEA
Sensor : 'AFT SURGE'
Frequency: 50 (Hz)
Test Time : 81:02:08:02:30
Calibration: 1.1834 (g'/v)

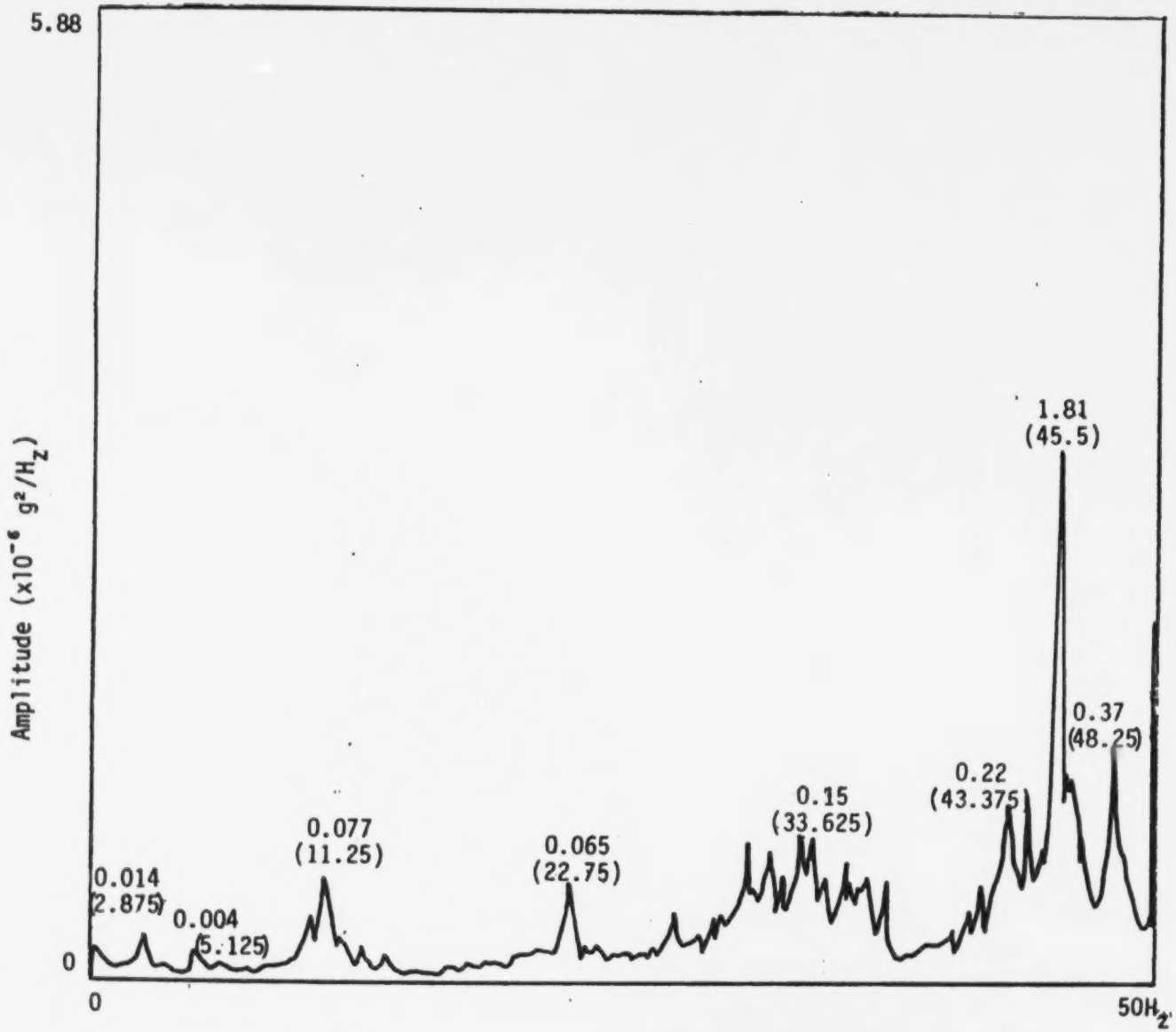


FIGURE 6.14g PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4′ avg.3.5′)
Vessel : USCGC POLAR SEA Test Time : 81:02:08:02:30
Sensor : AFT SWAY′ Calibration: 1.2270 (g′/v)
Frequency: 50 (Hz)

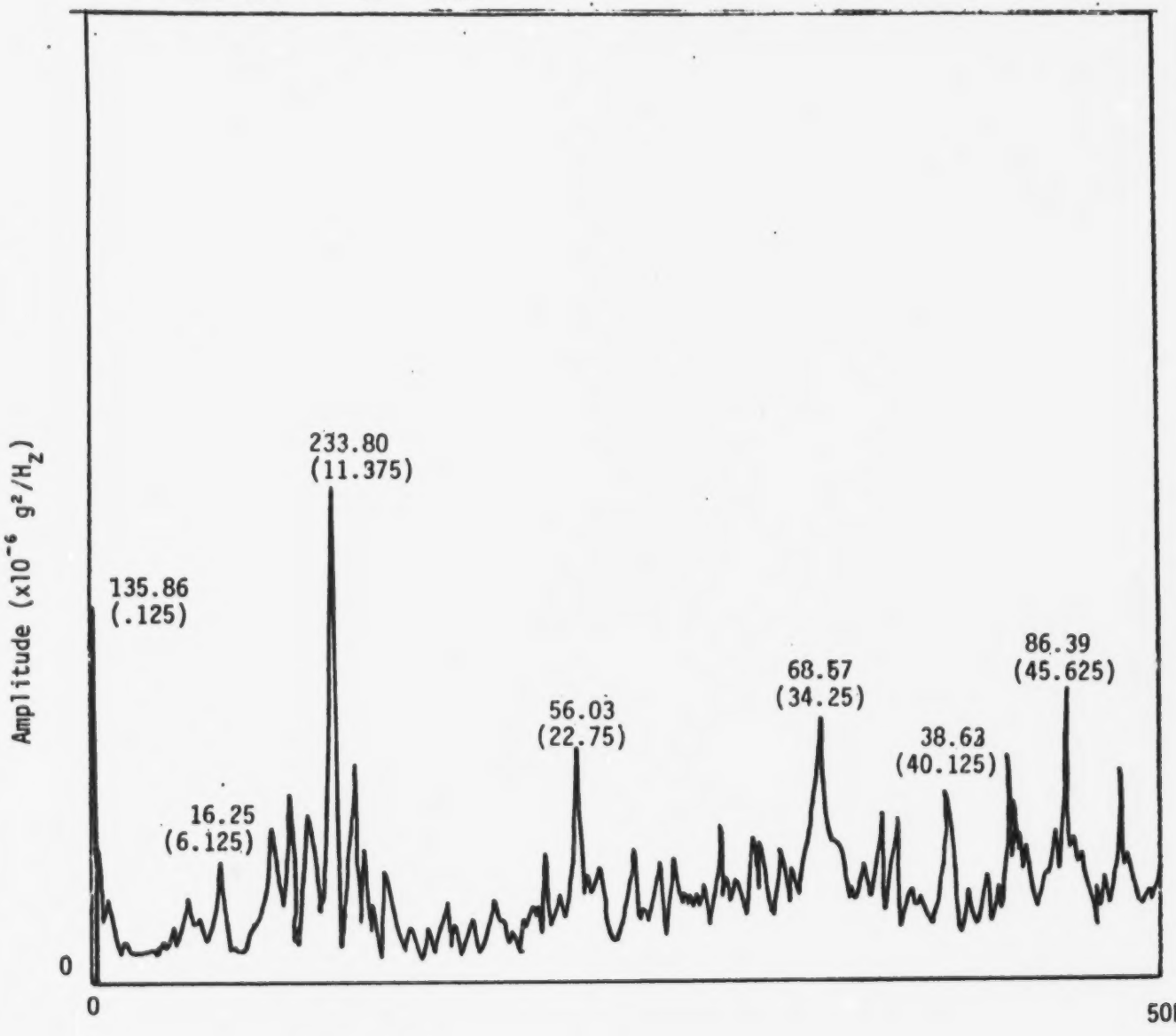


FIGURE 6.14h PEAK AVERAGE ACCELERATION SPECTRUM

Event :RAMMING PRESSURE RIDGE (OBLIQUE 6 Kts Ice: max.4' avg.3.5')
Vessel : USCGC POLAR SEA
Sensor : 'AFT HEAVE'
Frequency: 50 (Hz)
Test Time : 81:02:08:02:30
Calibration: 1.2345 (g'/v)

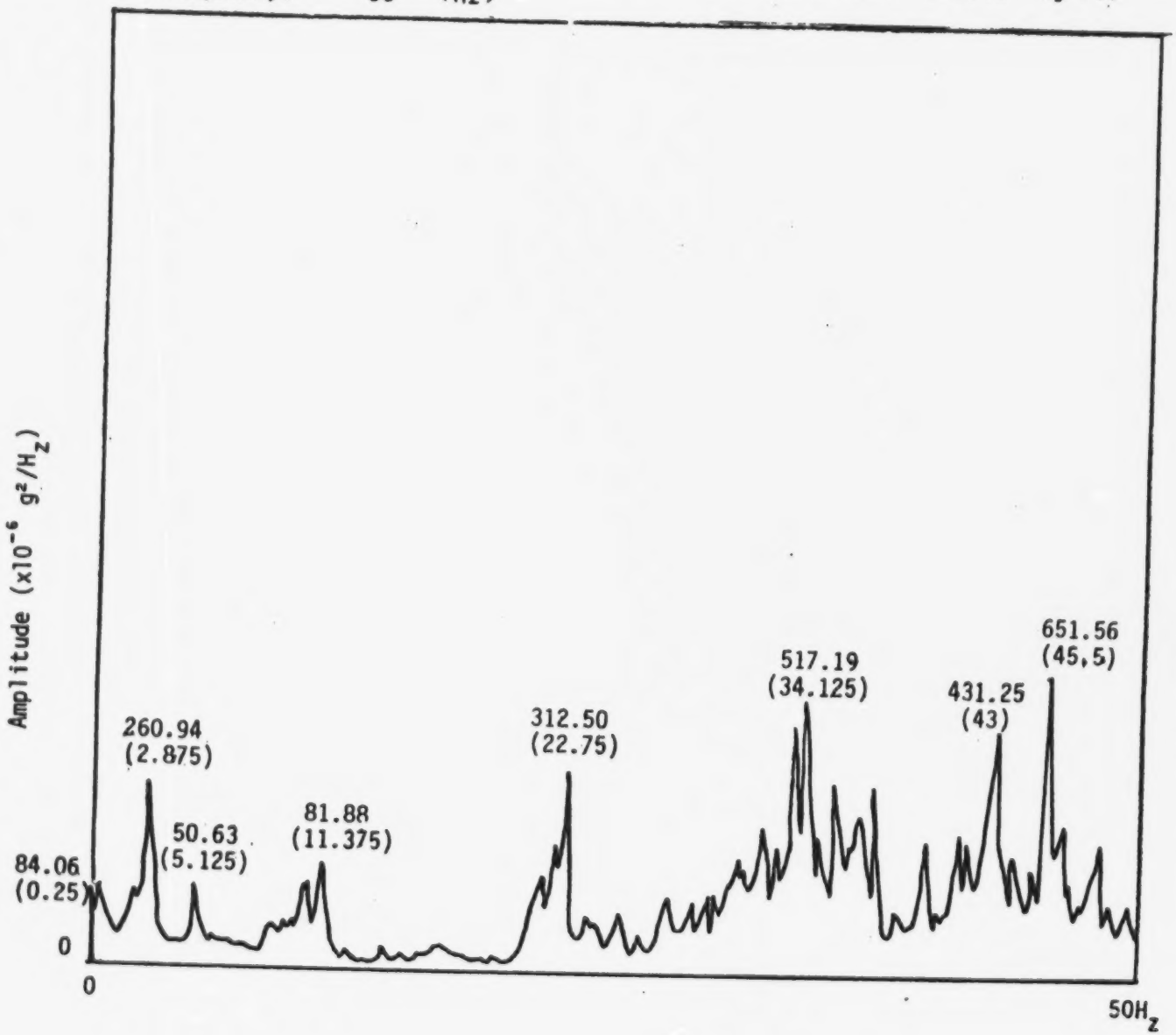


FIGURE 6.15a PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (9 Kts Ice: max. 2')
Vessel : USCGC POLAR SEA Test Time : 81:02:08:23:50
Sensor : 'BOW SWAY' Calibration: 1.1940 (g'/v)
Frequency: 50 (Hz)

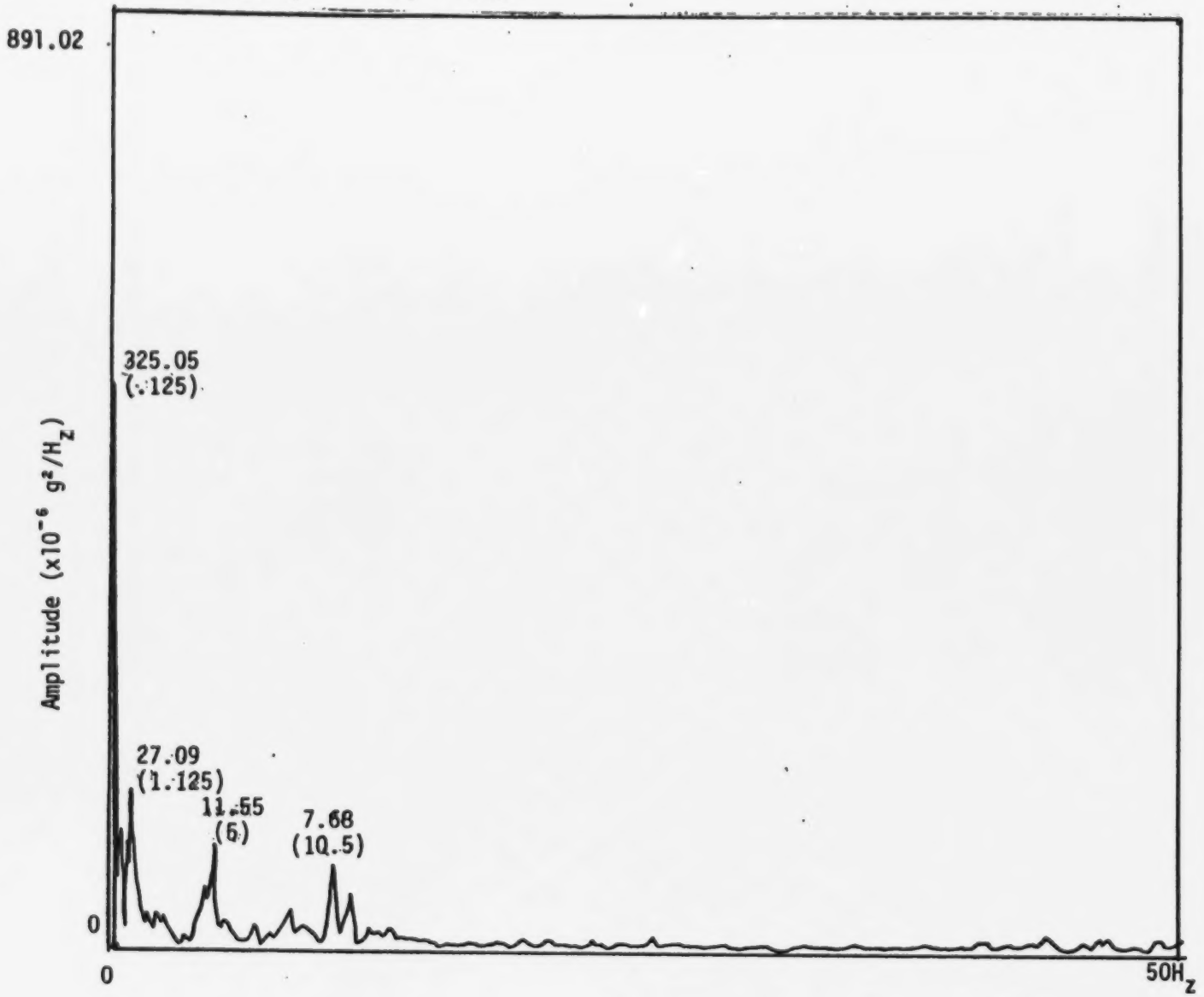


FIGURE 6.15b PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (9 Kts Ice: max. 2')
Vessel : USCGC POLAR SEA Test Time : 81:02:08:23:50
Sensor : 'BOW HEAVE' Calibration: 1.2500 (g'/v)
Frequency: 50 (Hz)

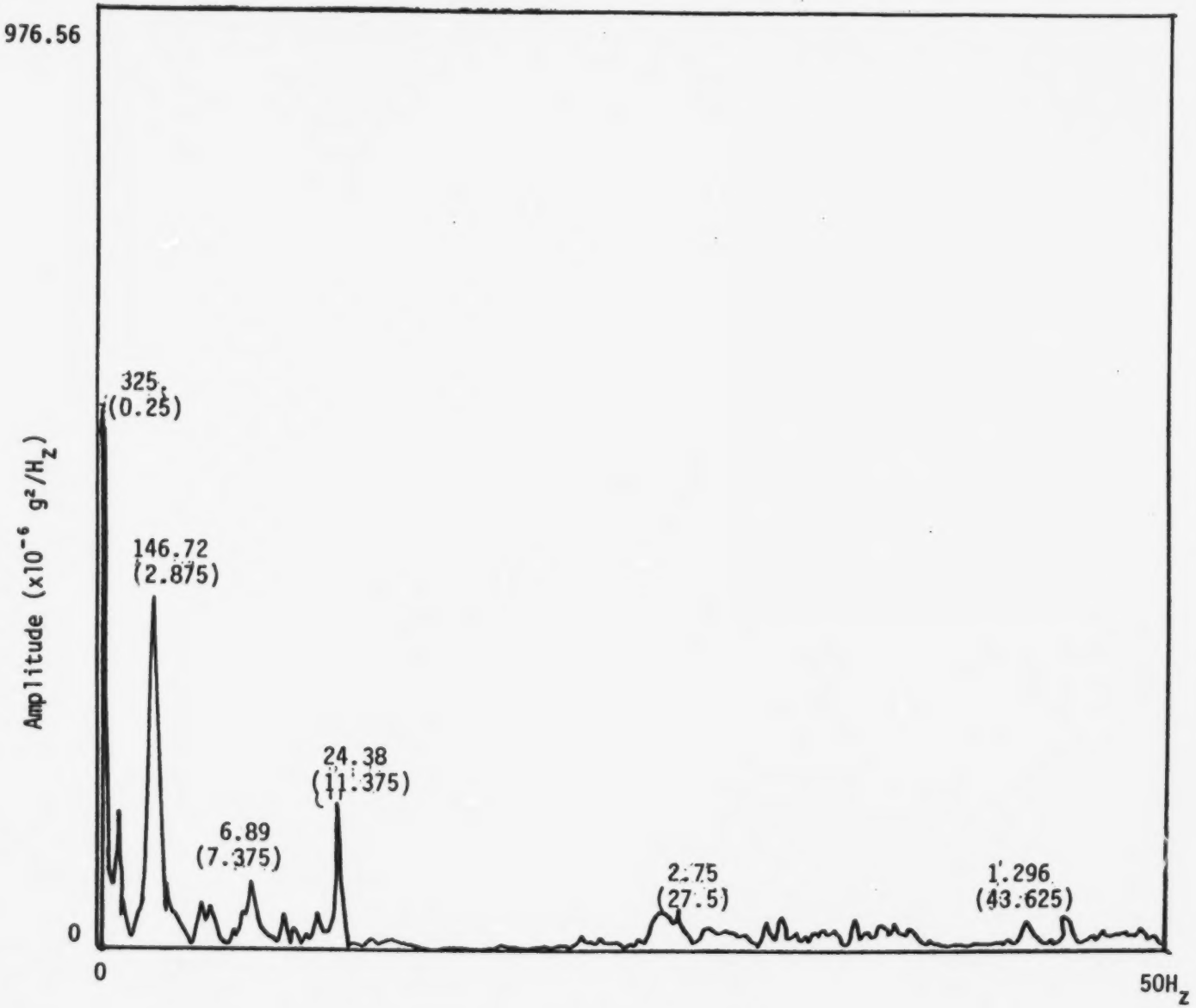


FIGURE 6.15c PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (9 Kts Ice: max. 2')
Vessel : USCGC POLAR SEA
Sensor : 'SURGE'
Frequency: 50 (Hz)
Test Time : 81:02:08:23:50
Calibration: .9591 (g'/v)

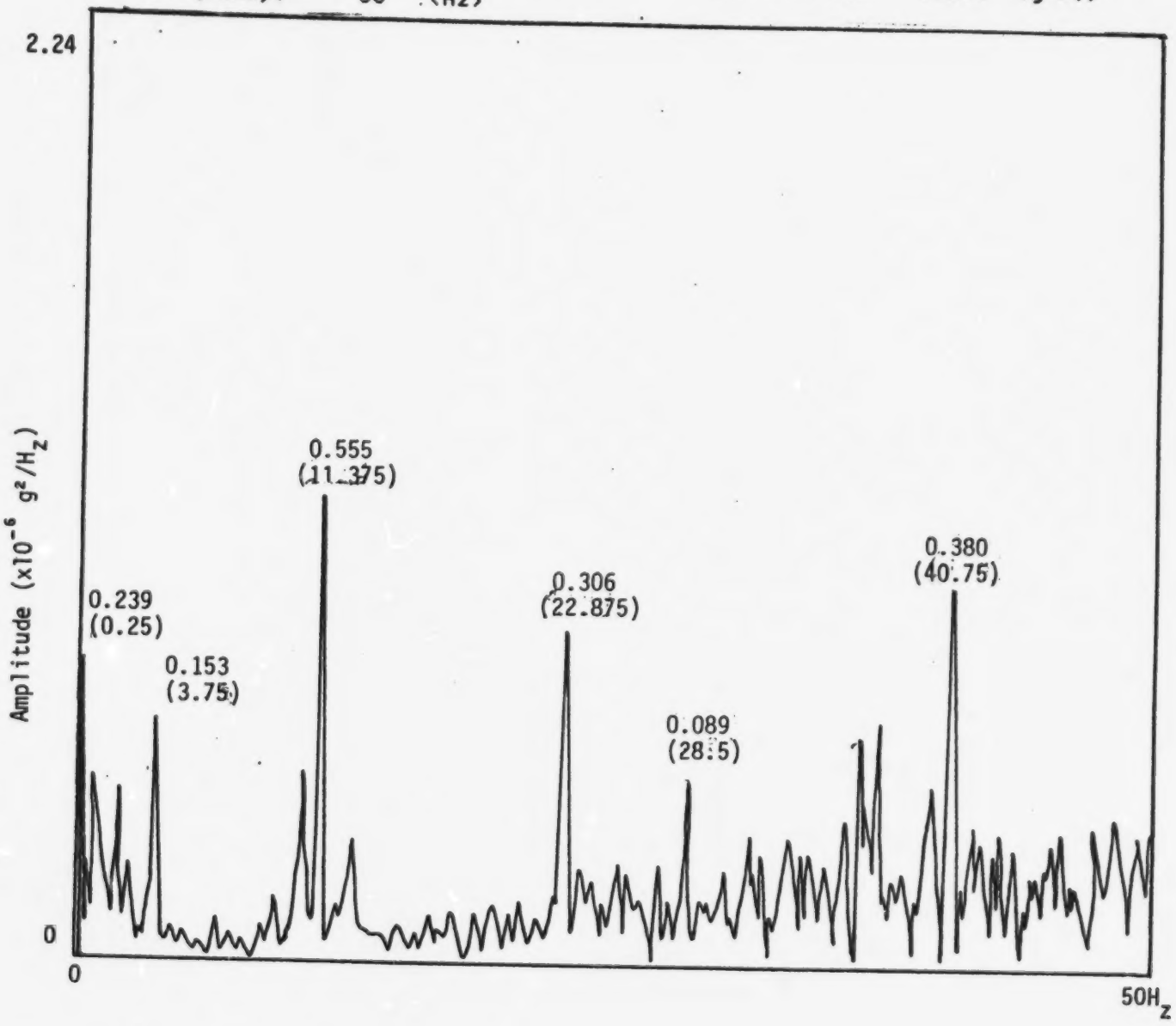


FIGURE 6.15d PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (9 Kts Ice: max. 2')
Vessel : USCGC POLAR SEA Test Time : 81:02:08:23:50
Sensor : 'SWAY' Calibration: .9547 (g'/v)
Frequency: 50 (Hz)

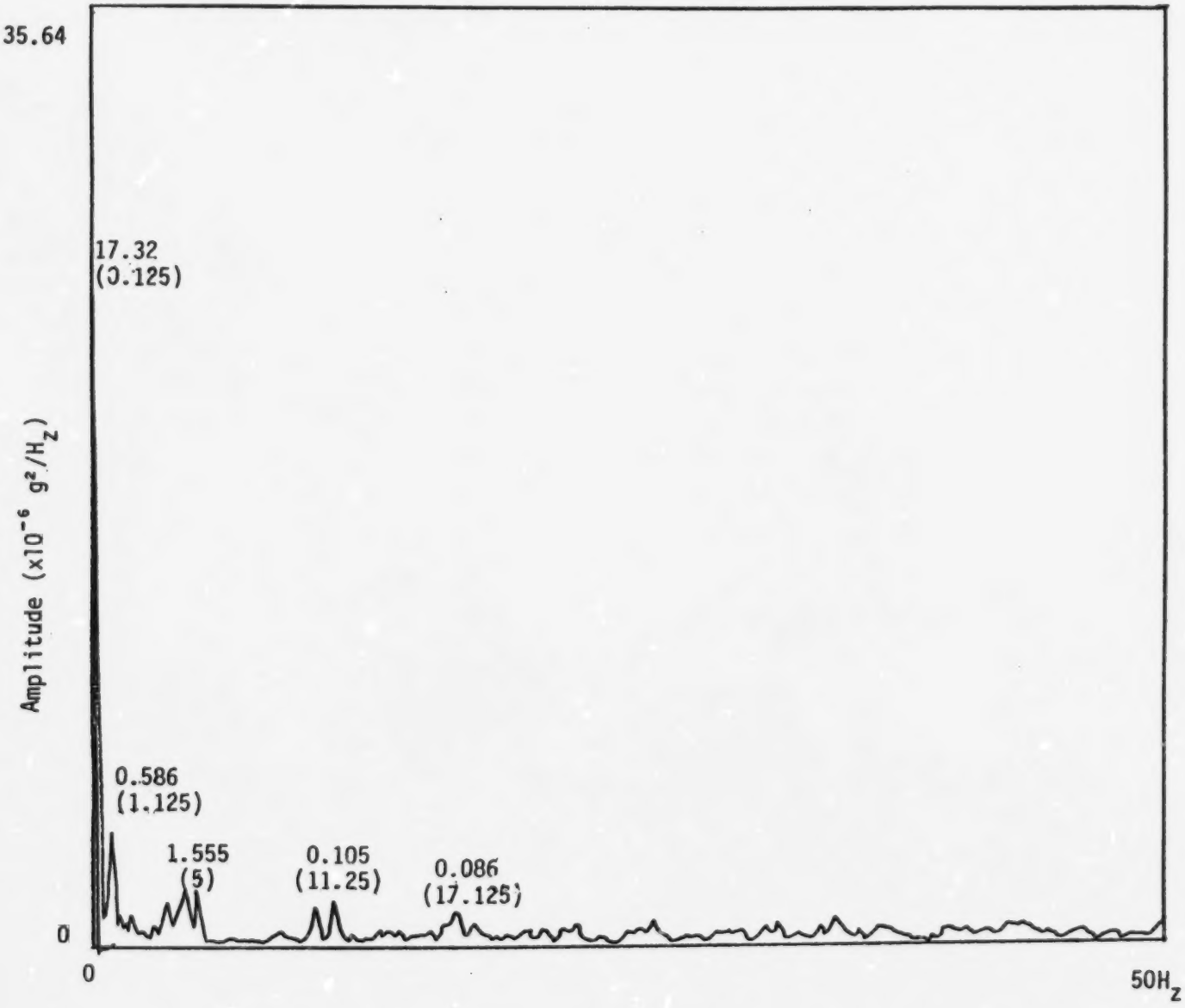


FIGURE 6.15e PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (9 Kts Ice: max. 2')
Vessel : USCGC POLAR SEA
Sensor : 'HEAVE'
Frequency: 50 (Hz)

Test Time : 81:02:08:23:50
Calibration: .9603 (g'/v)

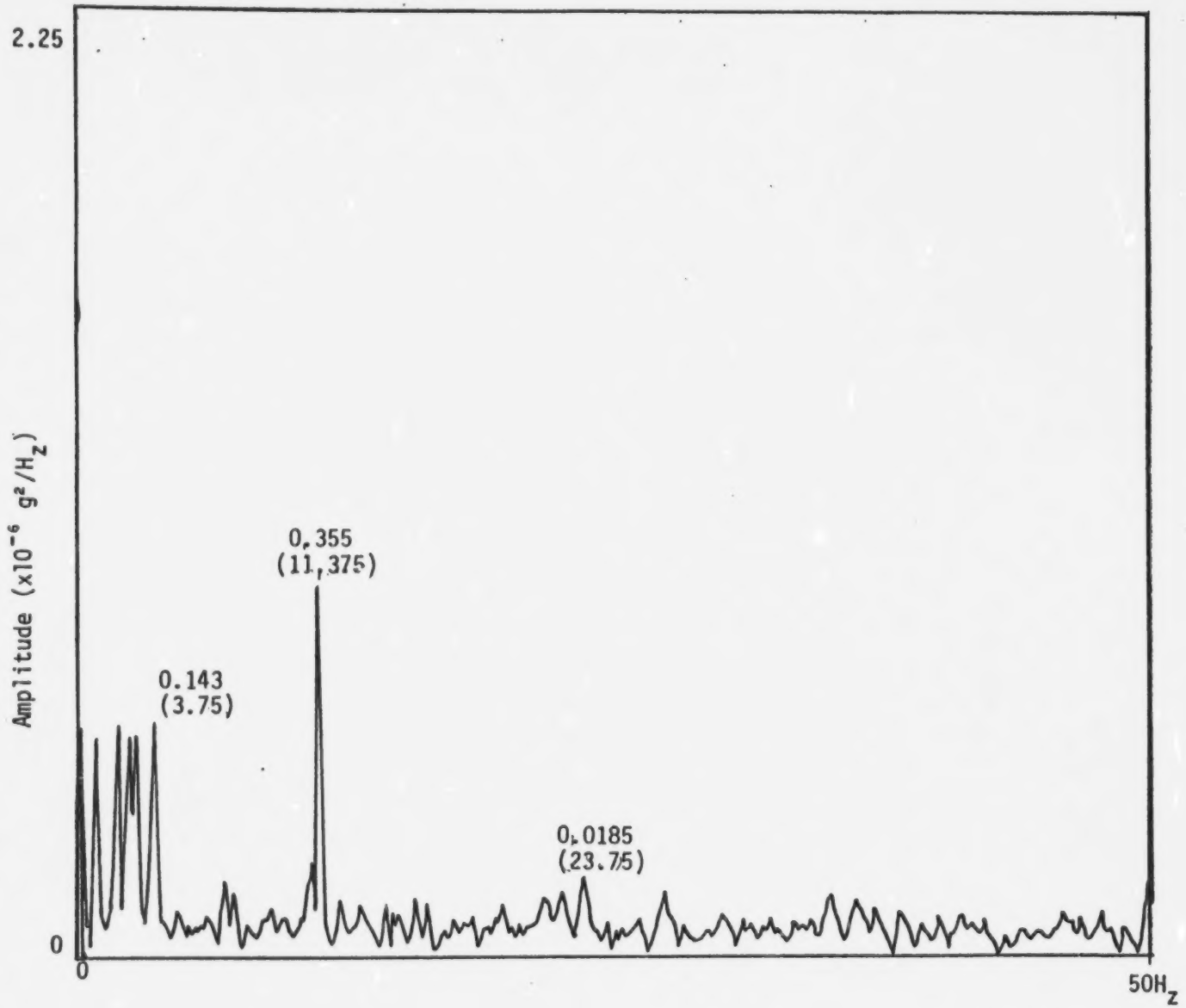


FIGURE 6.15f PEAK AVERAGE ACCELERATION SPECTRUM

Event : OBLIQUE IMPACT (9 Kts Ice: max. 2')
Vessel : USCGC POLAR SEA Test Time : 81:02:08:23:50
Sensor : 'AFT SURGE' Calibration: 1.1834 (g'/v)
Frequency: 50 (Hz)

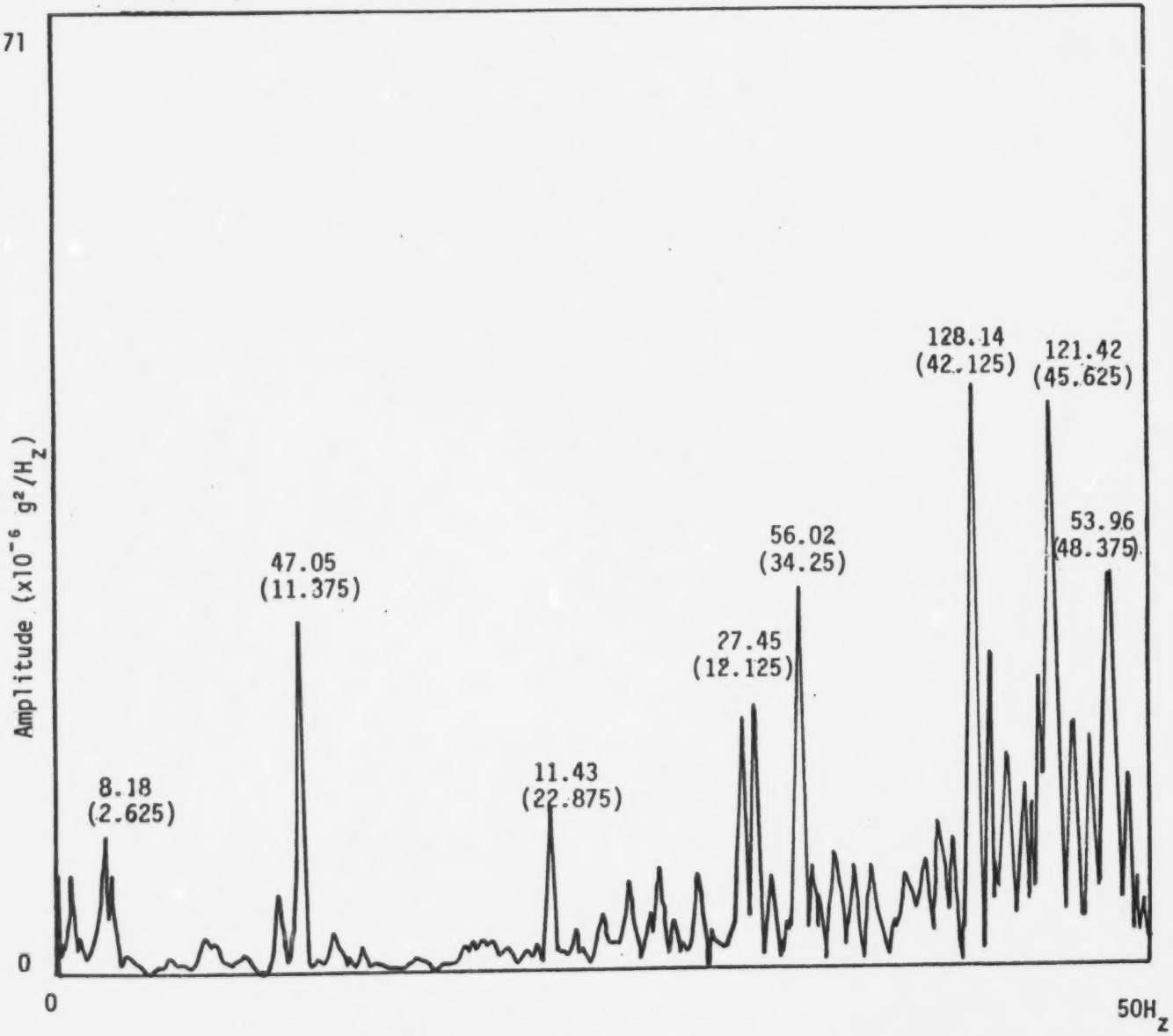


FIGURE 6.15g PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (9 Kts Ice: max. 2')
Vessel : USCGC POLAR SEA
Sensor : AFT SWAY'
Frequency: 50 (Hz)
Test Time : 81:02:08:23:50
Calibration: 1.2270 (g'/v)

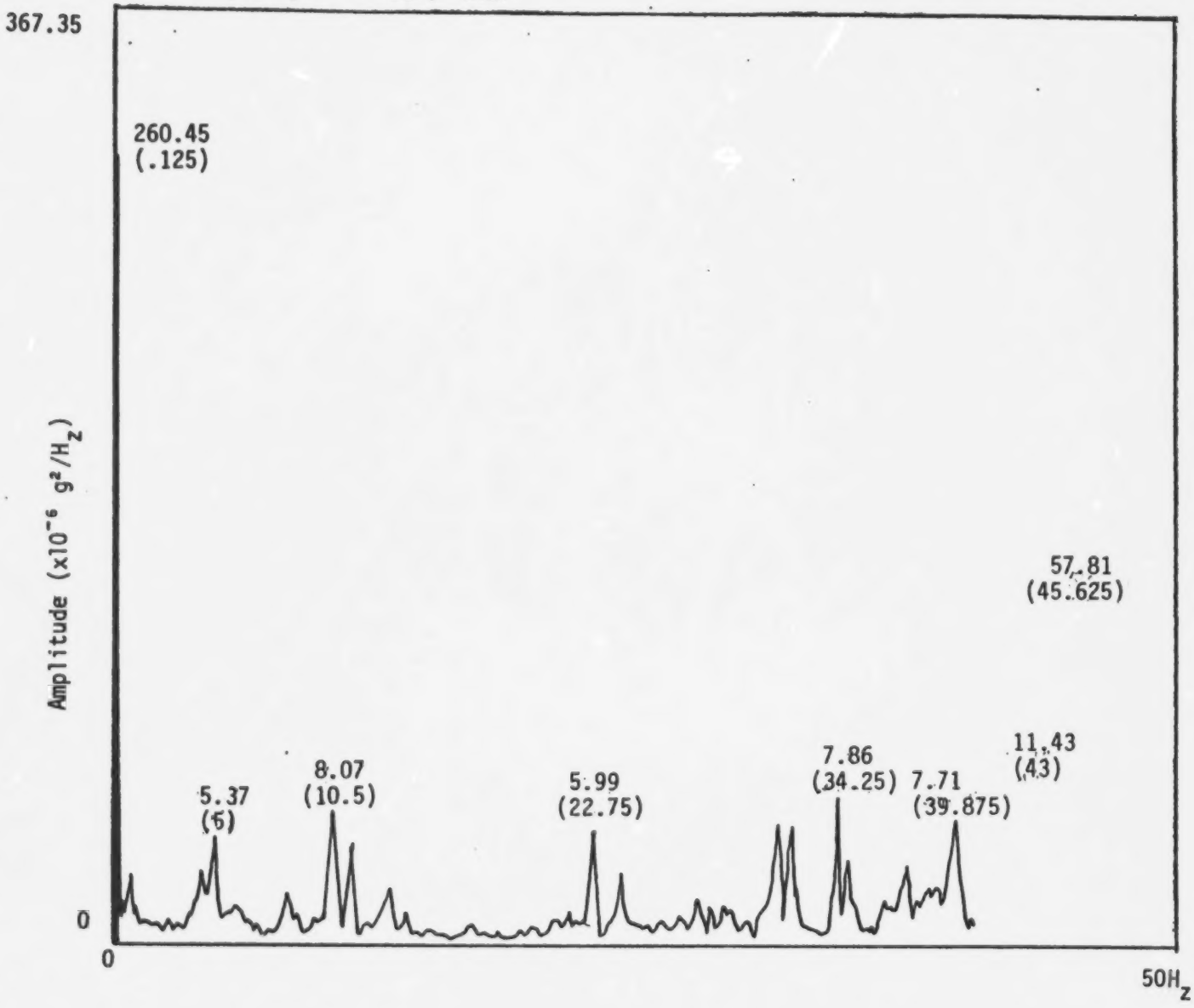


FIGURE 6.15h PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (9 Kts Ice: max. 2')
Vessel : USCGC POLAR SEA Test Time : 81:02:08:23:50
Sensor : 'AFT HEAVE' Calibration: 1.2345 (g'/v)
Frequency: 50 (Hz)

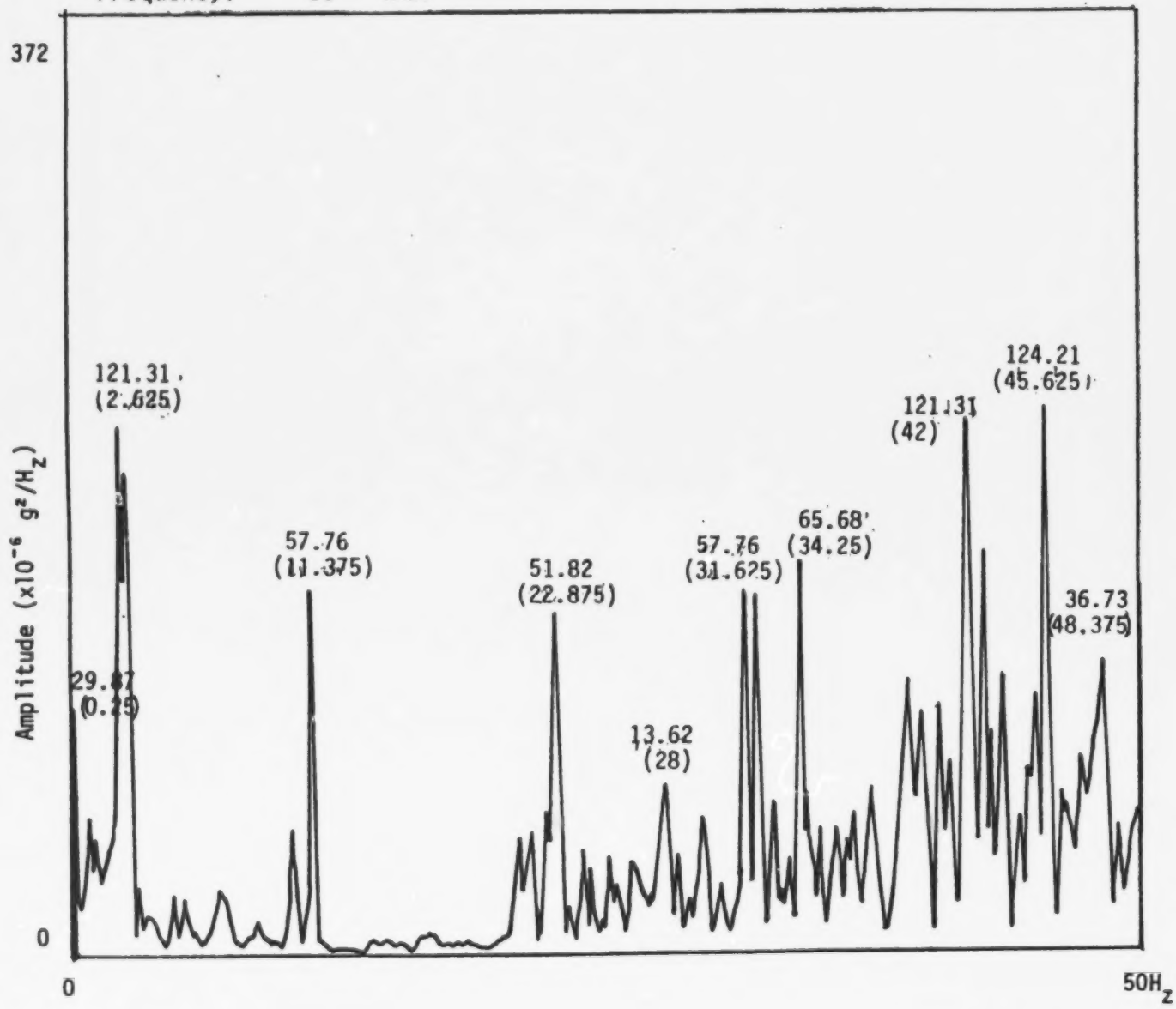


FIGURE 6.16a PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (7 Kts Ice: max. 4′ avg. 3′)
Vessel : USCGC POLAR SEA
Sensor : 'BOW HEAVE'
Frequency: 50 (Hz)
Test Time : 81:02:09:06:26
Calibration: 1.2500 (g′/v)

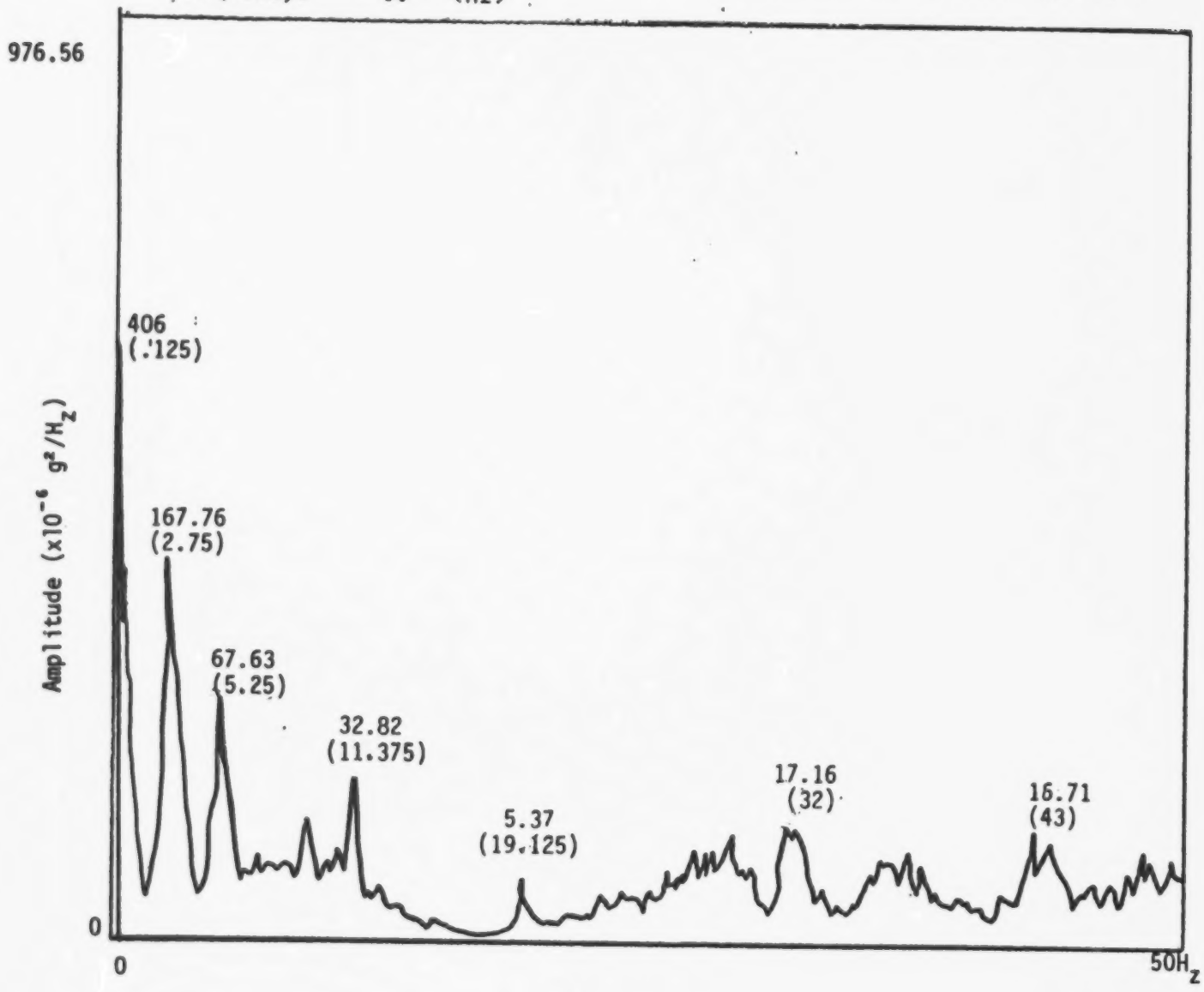


FIGURE 6.16b PEAK AVERAGE ACCELERATION SPECTRUM

Event : OBLIQUE IMPACT (7 Kts Ice: max. 4′ avg. 3′)
Vessel : USCGC POLAR SEA
Sensor : 'BOW SWAY'
Frequency: 50 (Hz)
Test Time : 81:02:09:06:26
Calibration: 1.1940 (g′/v)

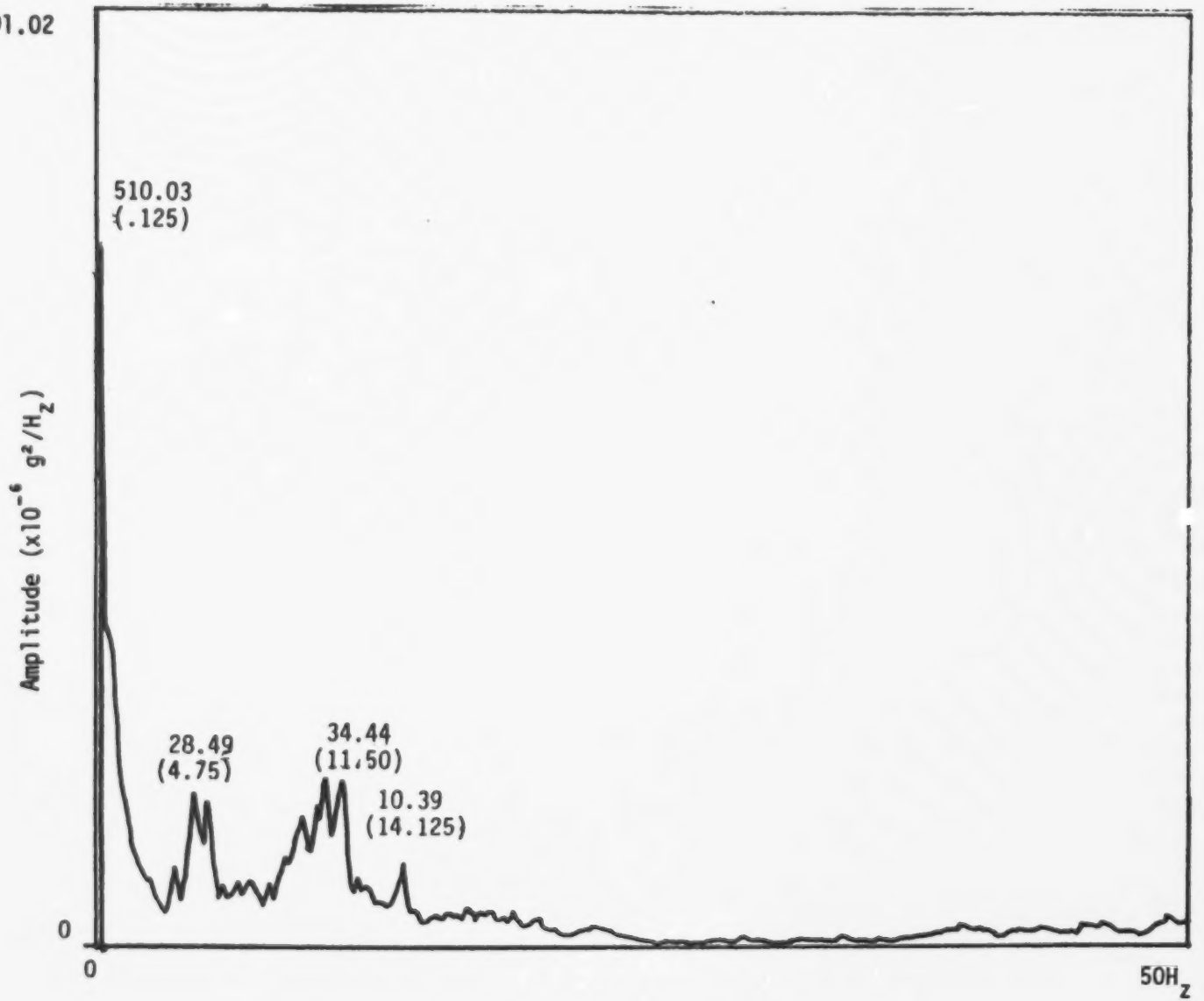


FIGURE 6.16c PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (7 Kts Ice: max. 4′ avg. 3′)
Vessel : USCGC POLAR SEA
Sensor : 'SURGE'
Frequency: 50 (Hz)
Test Time : 81:02:09:06:26
Calibration: .9591 (g′/v)

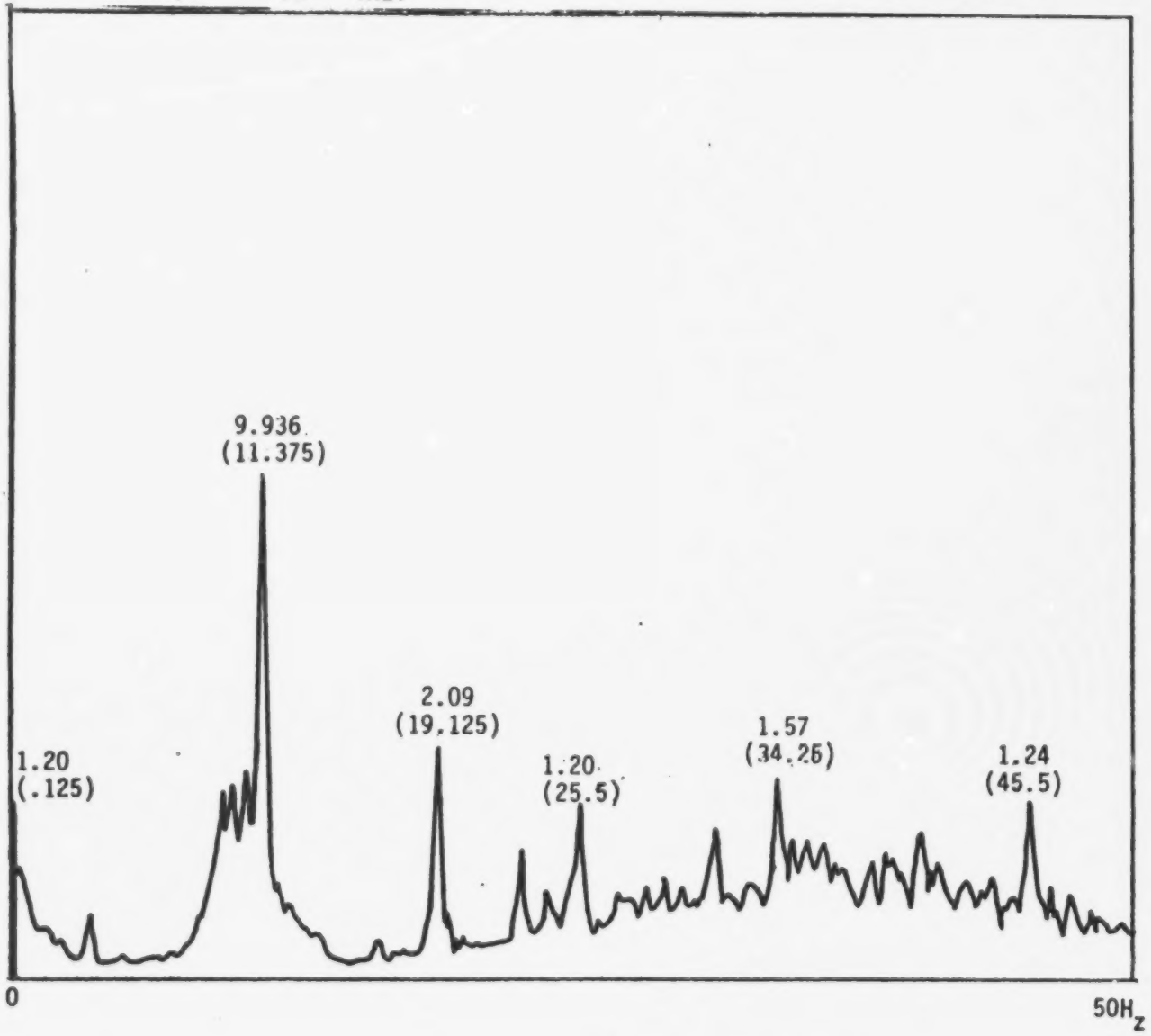


FIGURE 6.16d PEAK AVERAGE ACCELERATION SPECTRUM

Event : OBLIQUE IMPACT (7 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA Test Time : 81:02:09:06:26
Sensor : 'SWAY' Calibration: .9547 (g'/v)
Frequency: 50 (Hz)

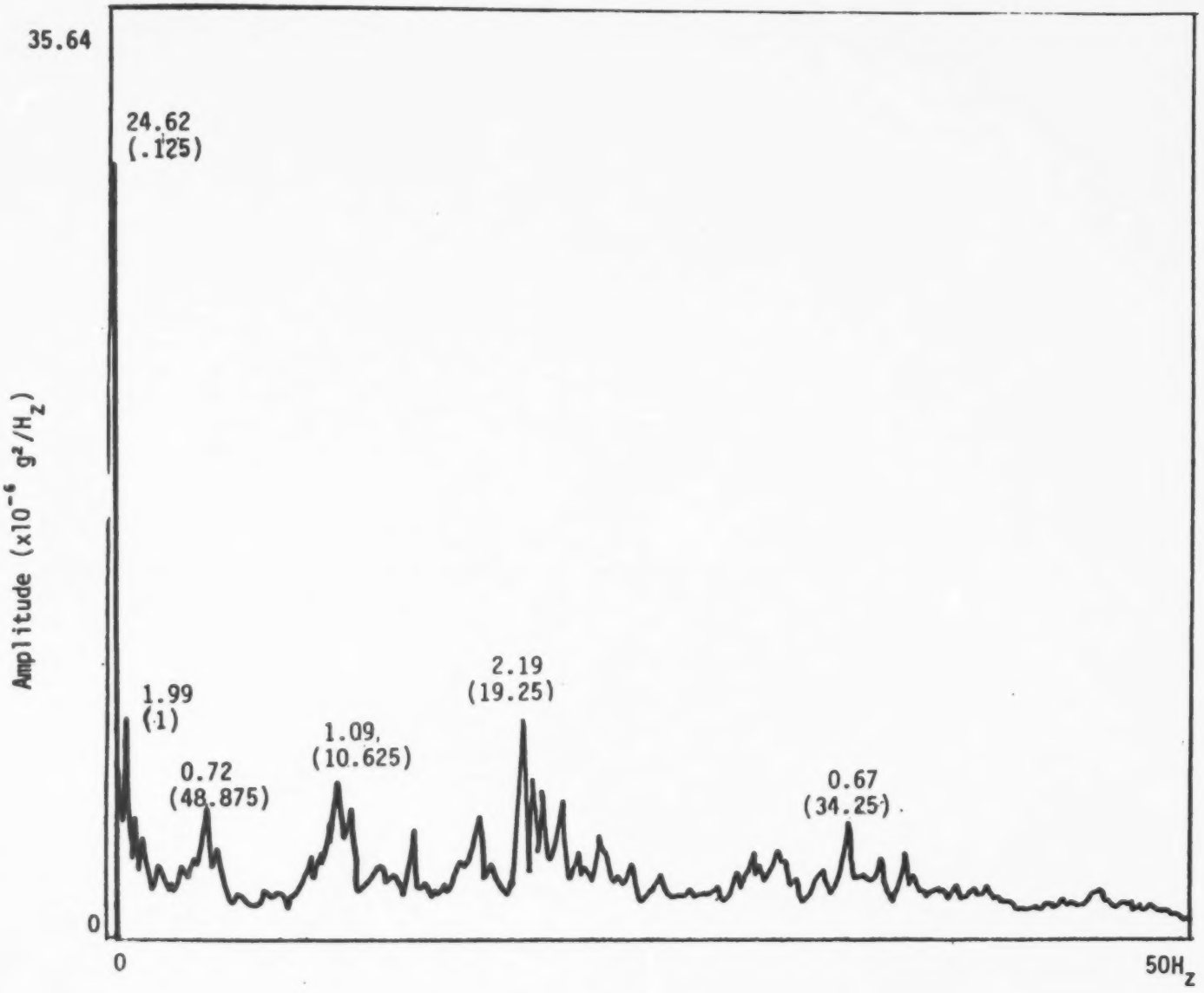


FIGURE 6.16e PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (7 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA
Sensor : 'HEAVE'
Frequency: 50 (Hz)
Test Time : 81:02:09:06:26
Calibration: .9603 (g'/v)

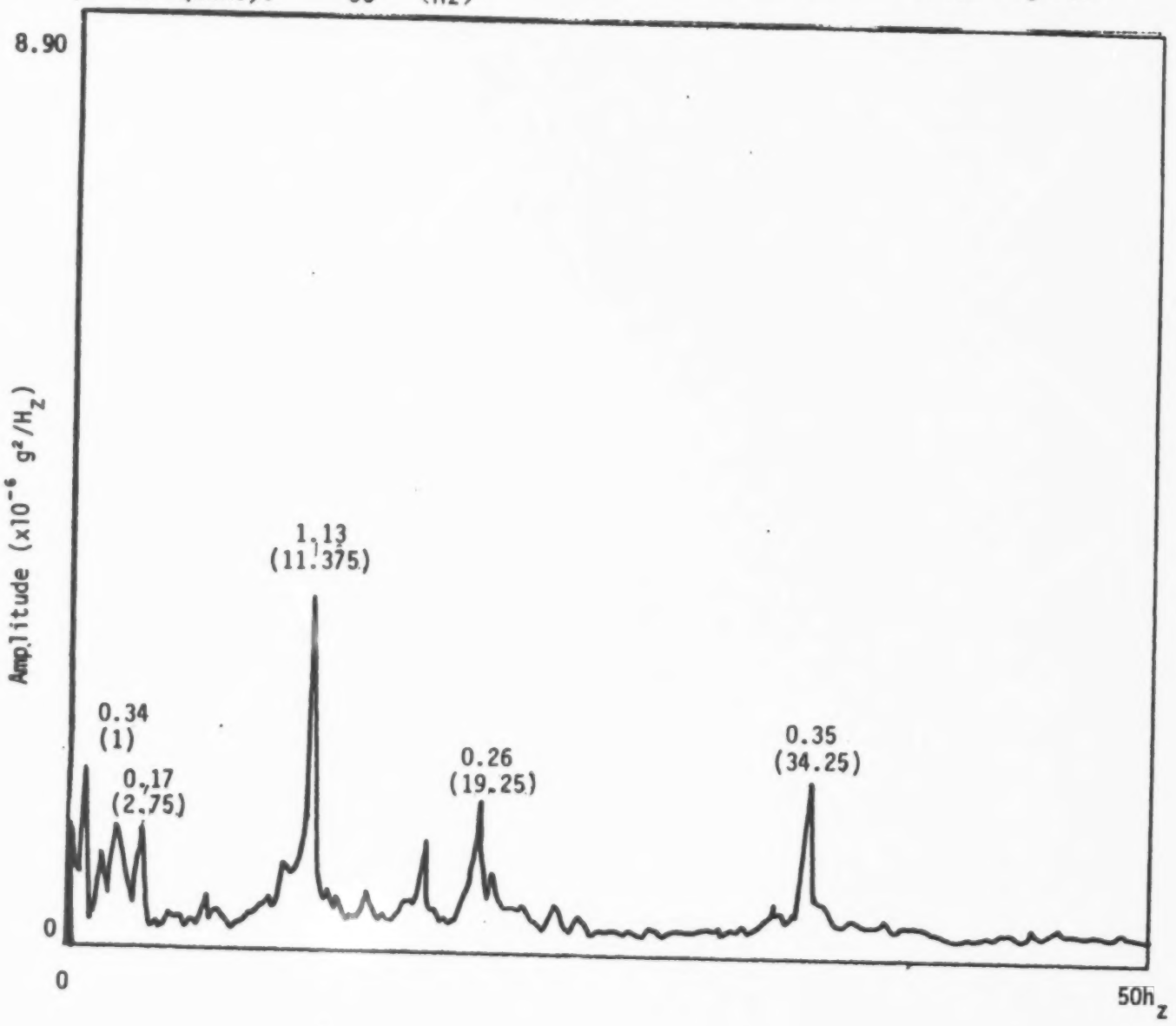


FIGURE 6.16f PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (7 Kts Ice: max. 4′ avg. 3′)
Vessel : USCGC POLAR SEA Test Time : 81:02:09:06:26
Sensor : 'AFT SURGE' Calibration: 1.1834 (g′/v)
Frequency: 50 (Hz)

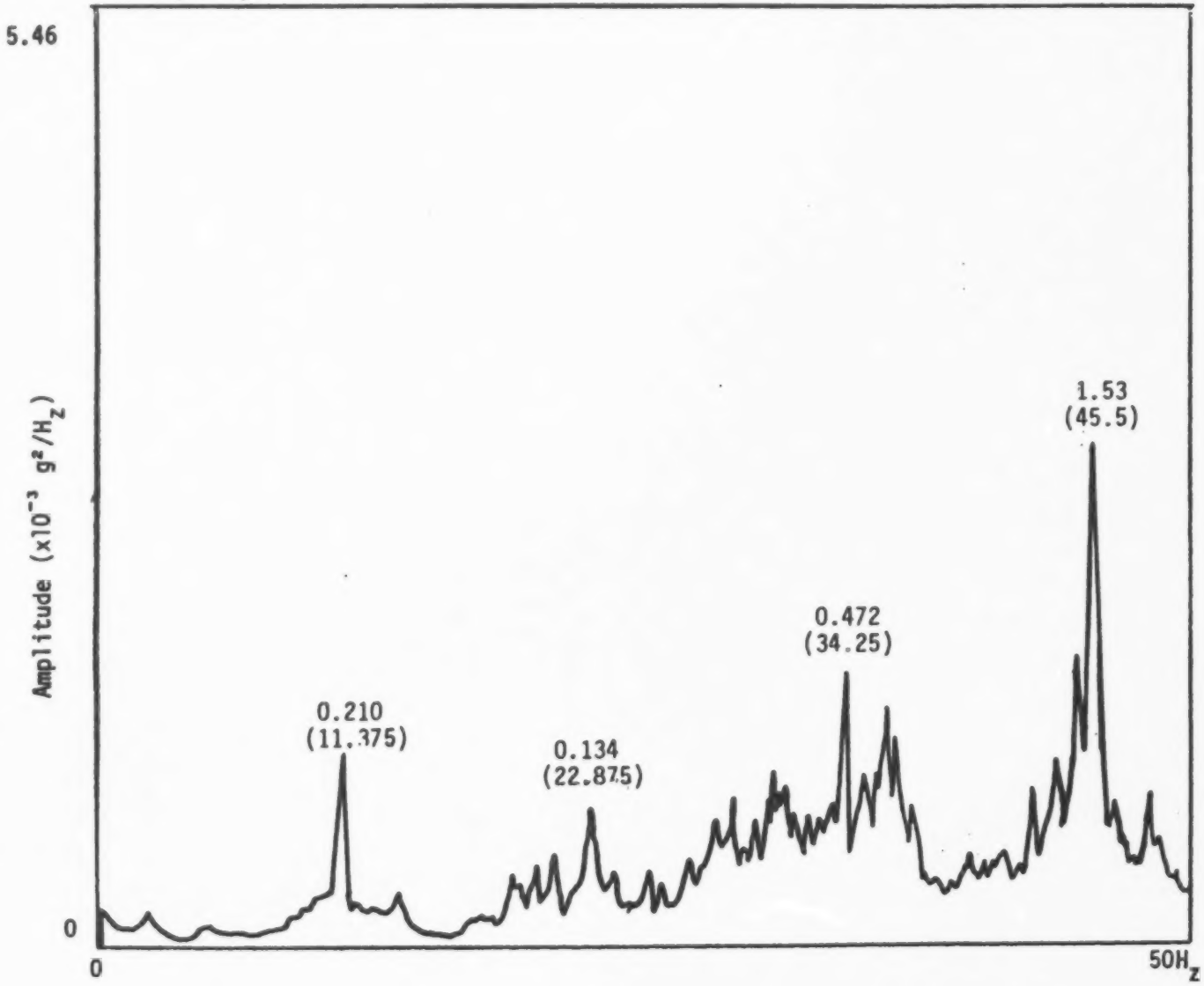


FIGURE 6.16g PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (7 Kts Ice: max. 4′ avg. 3′)
Vessel : USCGC POLAR SEA
Sensor : AFT SWAY′
Frequency: 50 (Hz)
Test time : 81:02:09:06:26
Calibration : 1.2270 (g′/v)

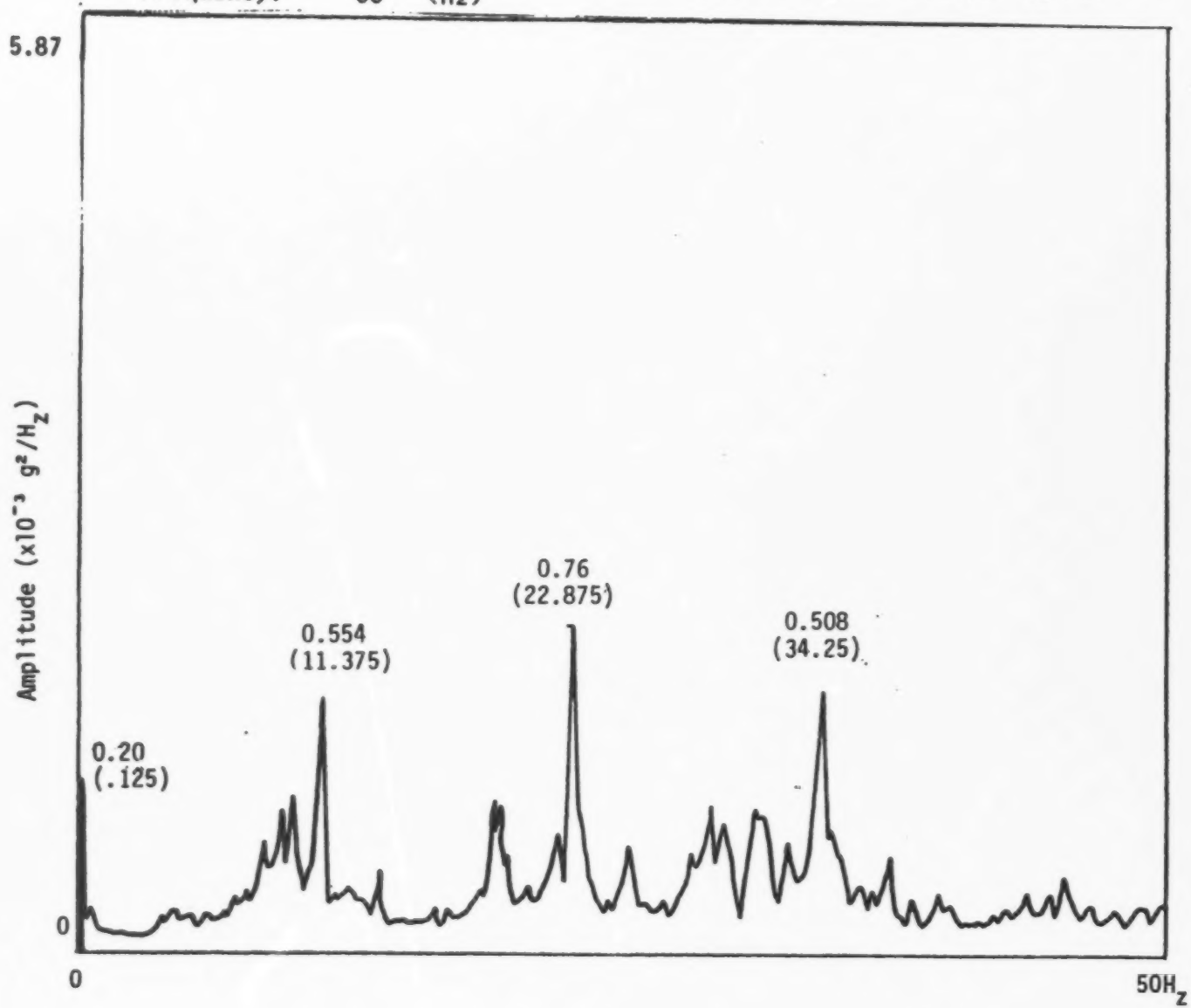


FIGURE 6.16h PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (7 Kts Ice: max. 4′ avg. 3′)
Vessel : USCGC POLAR SEA Test Time : 81:02:09:06:26
Sensor : 'AFT HEAVE' Calibration: 1.2345 (g′/v)
Frequency: 50 (Hz)

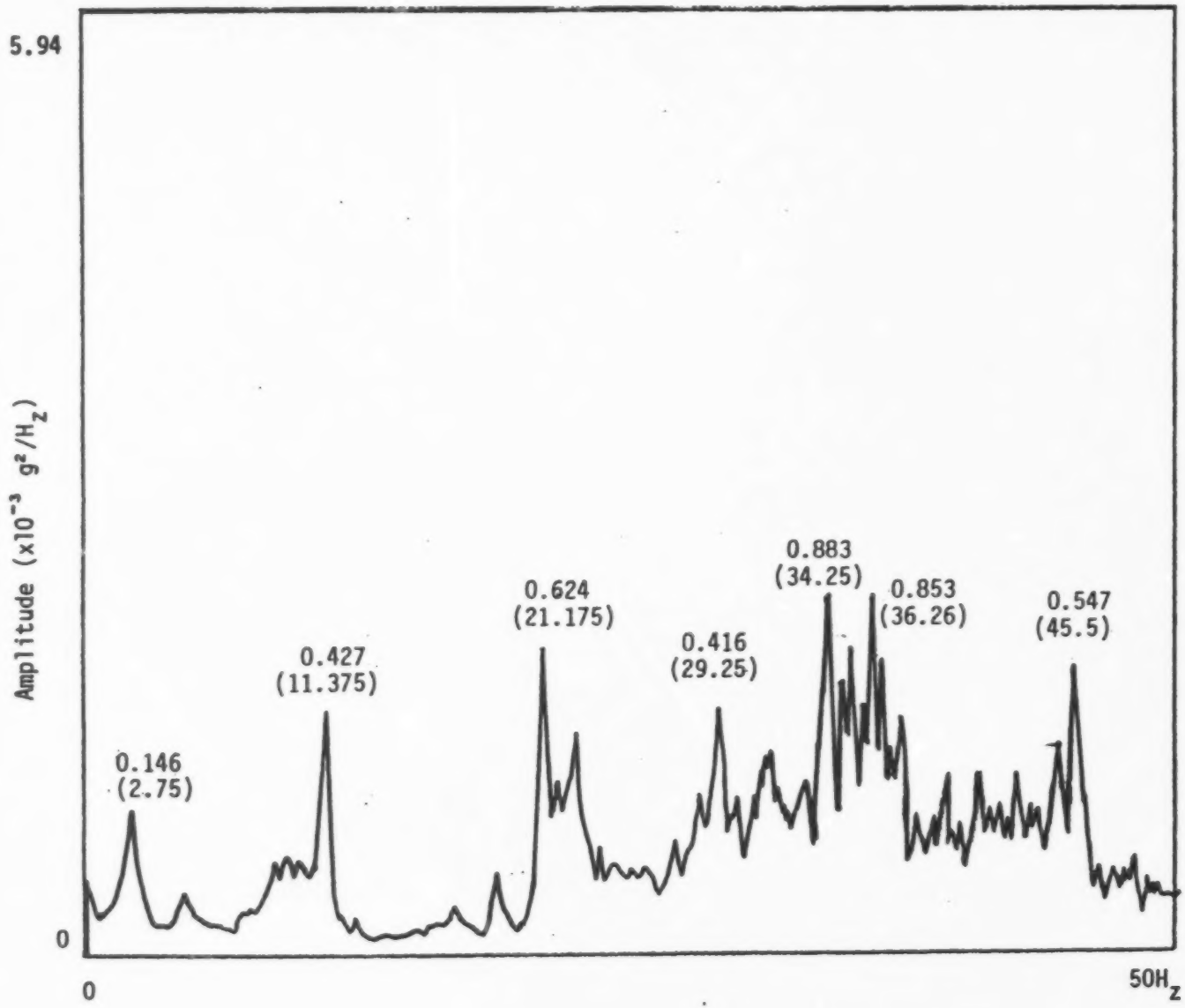


FIGURE 6.17a PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (7 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA Test Time : 81:02:09:06:26
Sensor : 'BOW SWAY' Calibration: 1.1940 (g'/v)
Frequency: 500 (Hz)

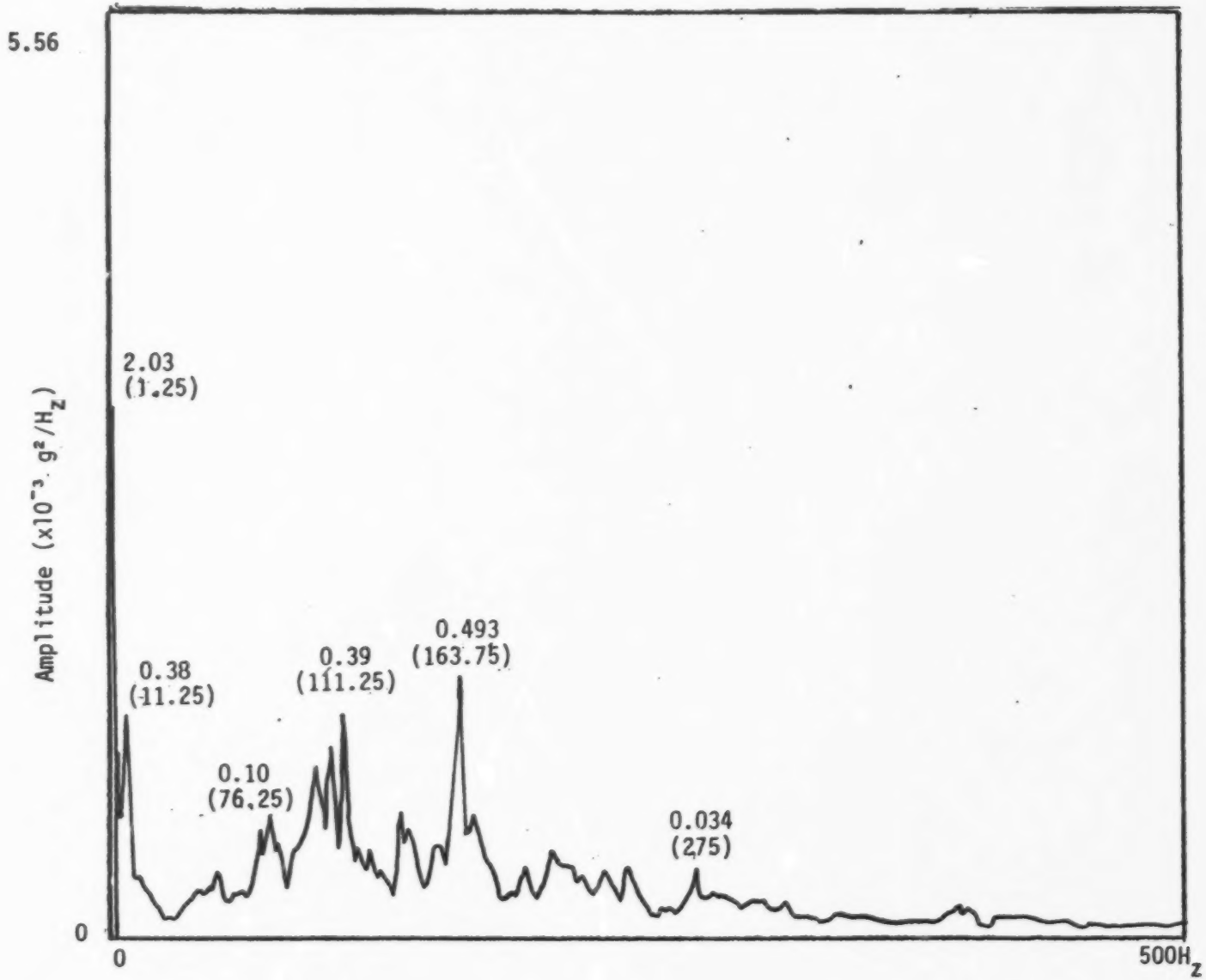


FIGURE 6.17b PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (7 Kts Ice: max. 4′ avg. 3′)
Vessel : USCGC POLAR SEA Test Time : 81:02:09:06:26
Sensor : ′BOW HEAVE′ Calibration: 1.2500 (g′/v)
Frequency: 500 (Hz)

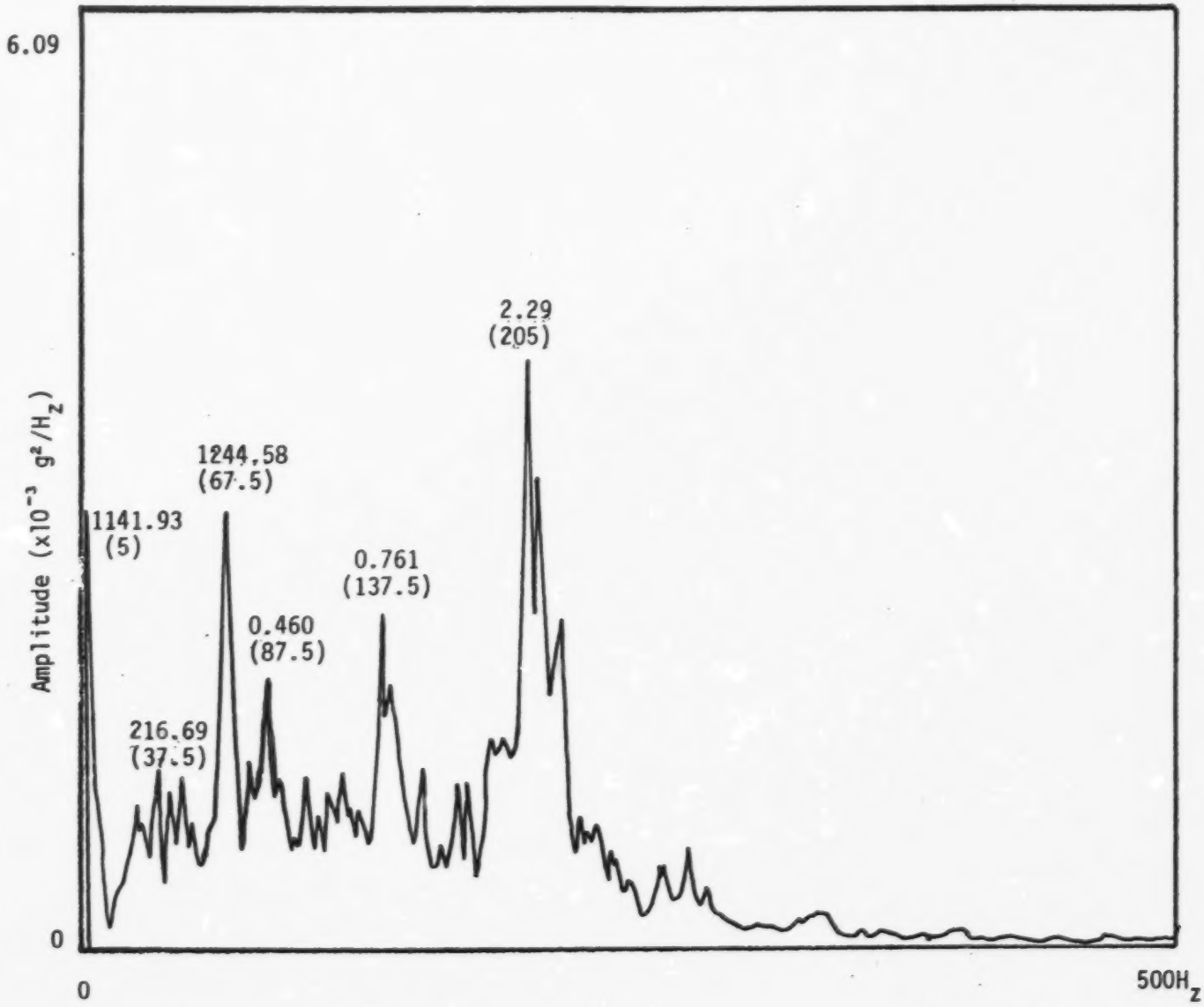


FIGURE 6.17c PEAK AVERAGE ACCELERATION SPECTRUM

Event : OBLIQUE IMPACT (7 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA
Sensor : 'SURGE'
Frequency: 500 (Hz)
Test Time : 81:02:09:06:26
Calibration: .9591 (g'/v)

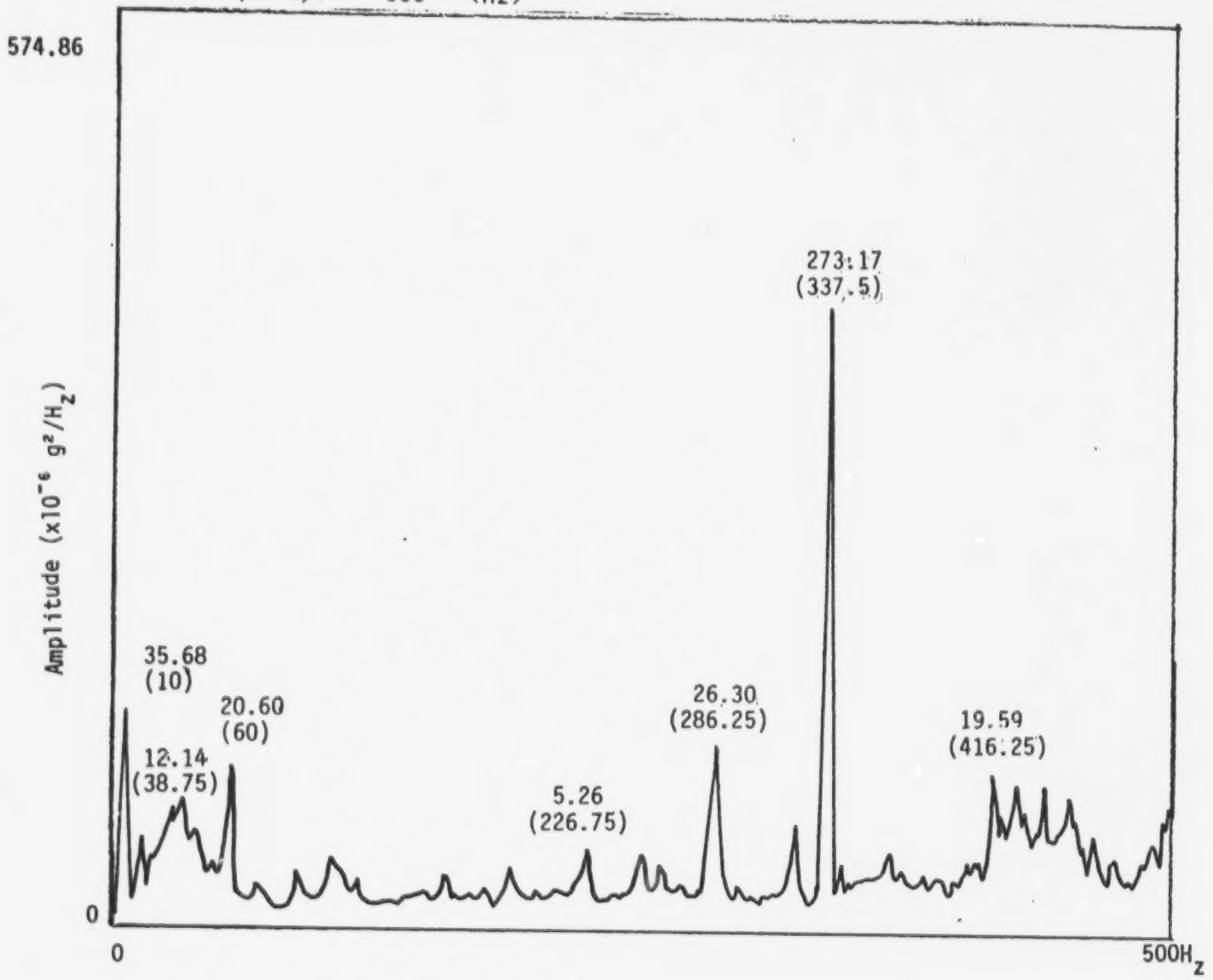


FIGURE 6.17d PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (7 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA Test Time : 81!02:09:06:26
Sensor : 'SWAY' Calibration: .9547 (g'/v)
Frequency: 500 (Hz)

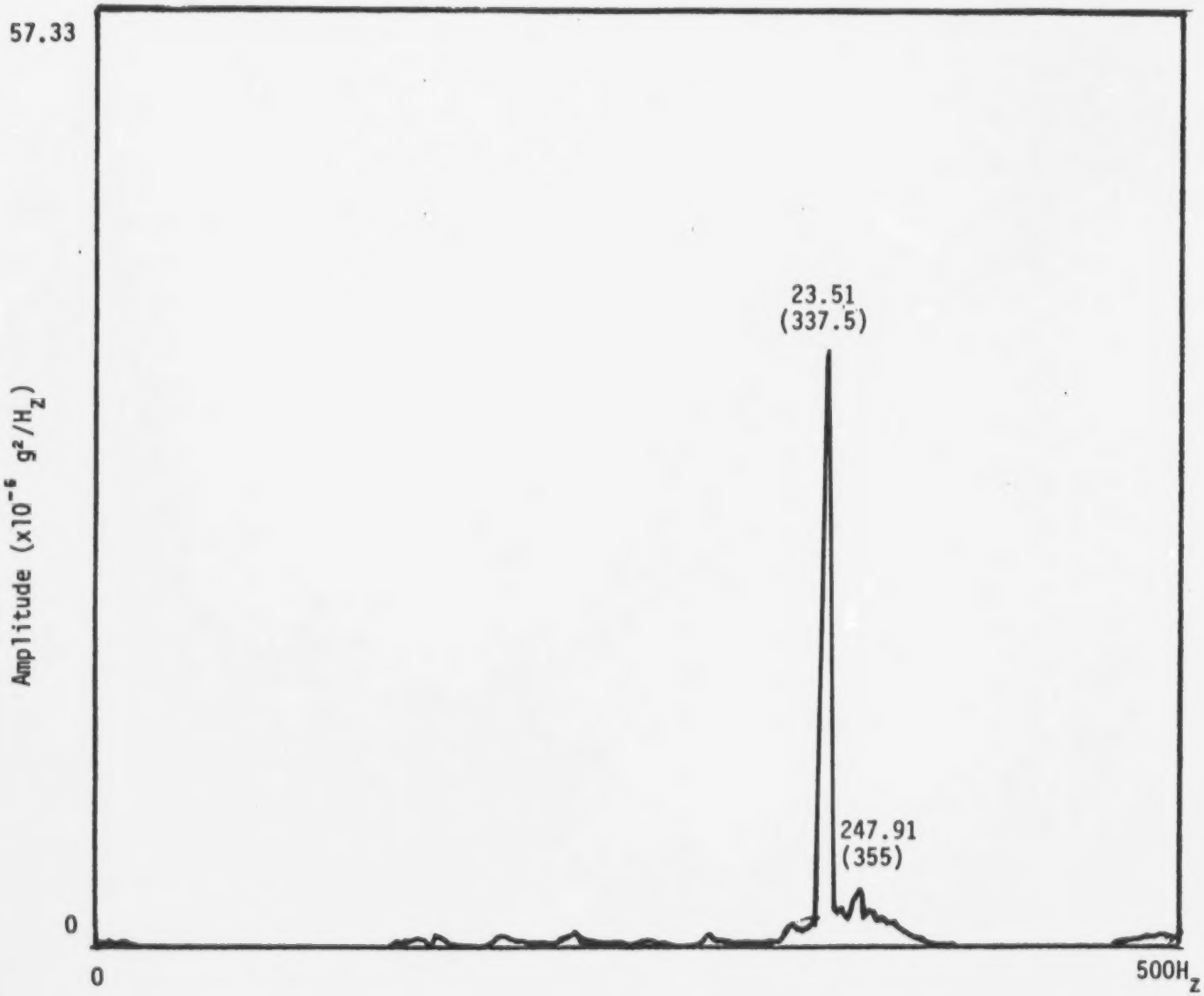


FIGURE 6.17e PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (7 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA
Sensor : 'HEAVE'
Frequency: 500 (Hz)
Test Time : 81:02:09:06:26
Calibration: .9603 (g'/v)

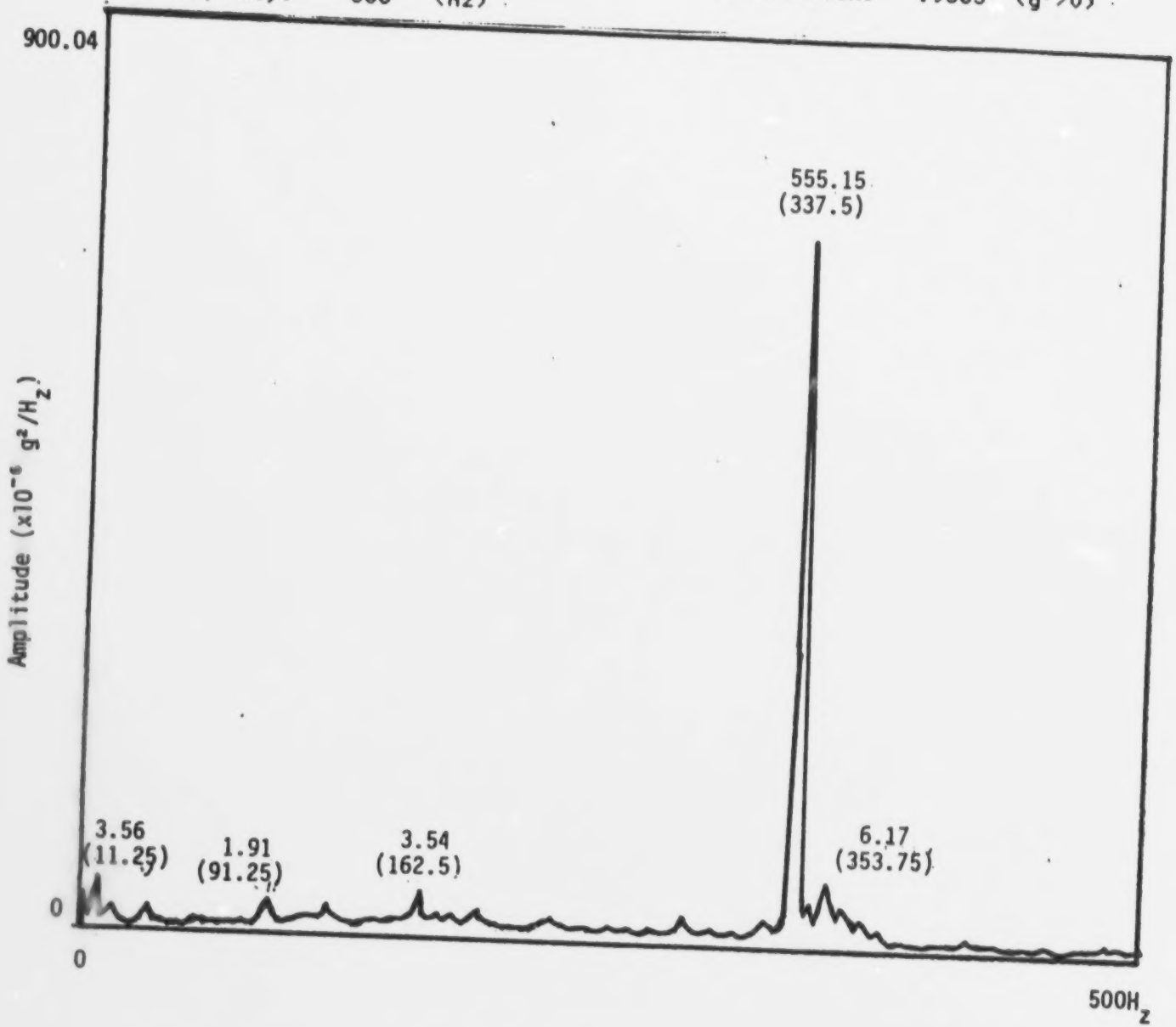


FIGURE 6.17f PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (7 Kts Ice: max. 4′ avg. 3′)
Vessel : USCGC POLAR SEA
Sensor : 'AFT SURGE'
Frequency: 500 (Hz)
Test Time : 81:02:09:06:26
Calibration: 1.1834 (g′/v)

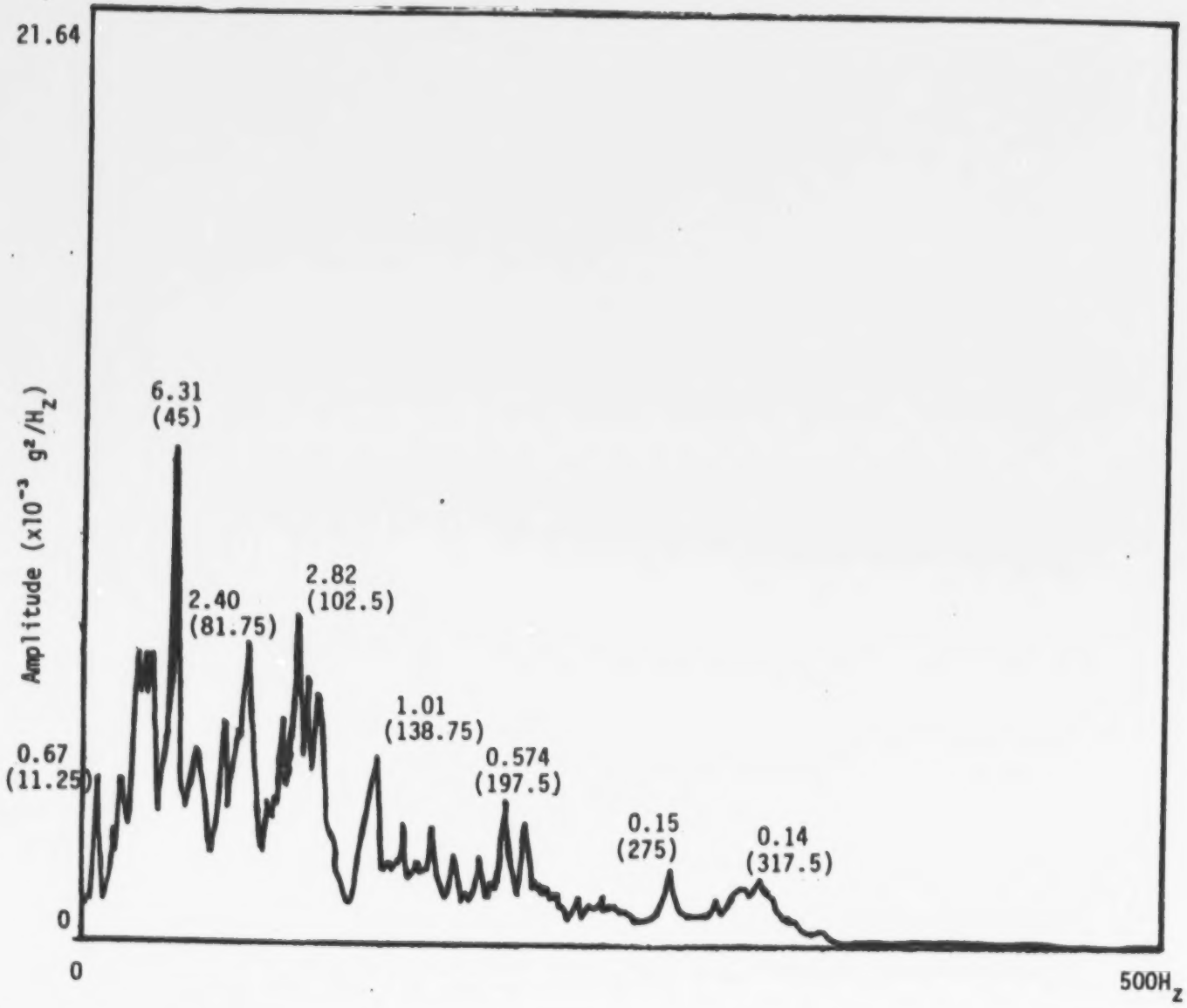


FIGURE 6.17g PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (7 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA
Sensor : AFT SWAY'
Frequency: 500 (Hz)
Test Time : 81:02:09:06:26
Calibration: 1.2270 (g'/v)

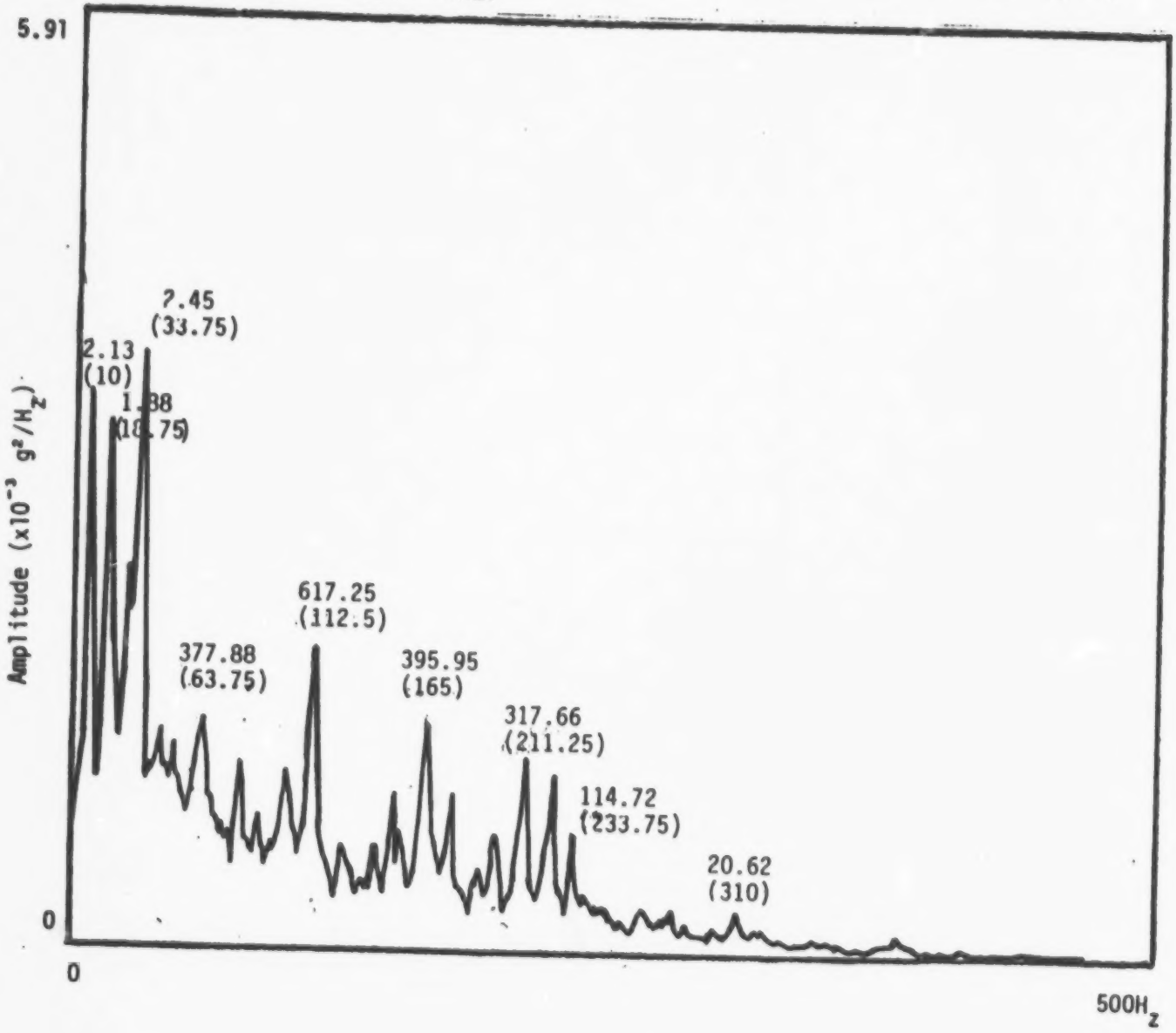


FIGURE 6.17h PEAK AVERAGE ACCELERATION SPECTRUM

Event :OBLIQUE IMPACT (7 Kts Ice: max. 4' avg. 3')
Vessel : USCGC POLAR SEA Test Time : 81:02:09:06:26
Sensor : 'AFT HEAVE' Calibration: 1.2345 (g'/v)
Frequency: 500 (Hz)

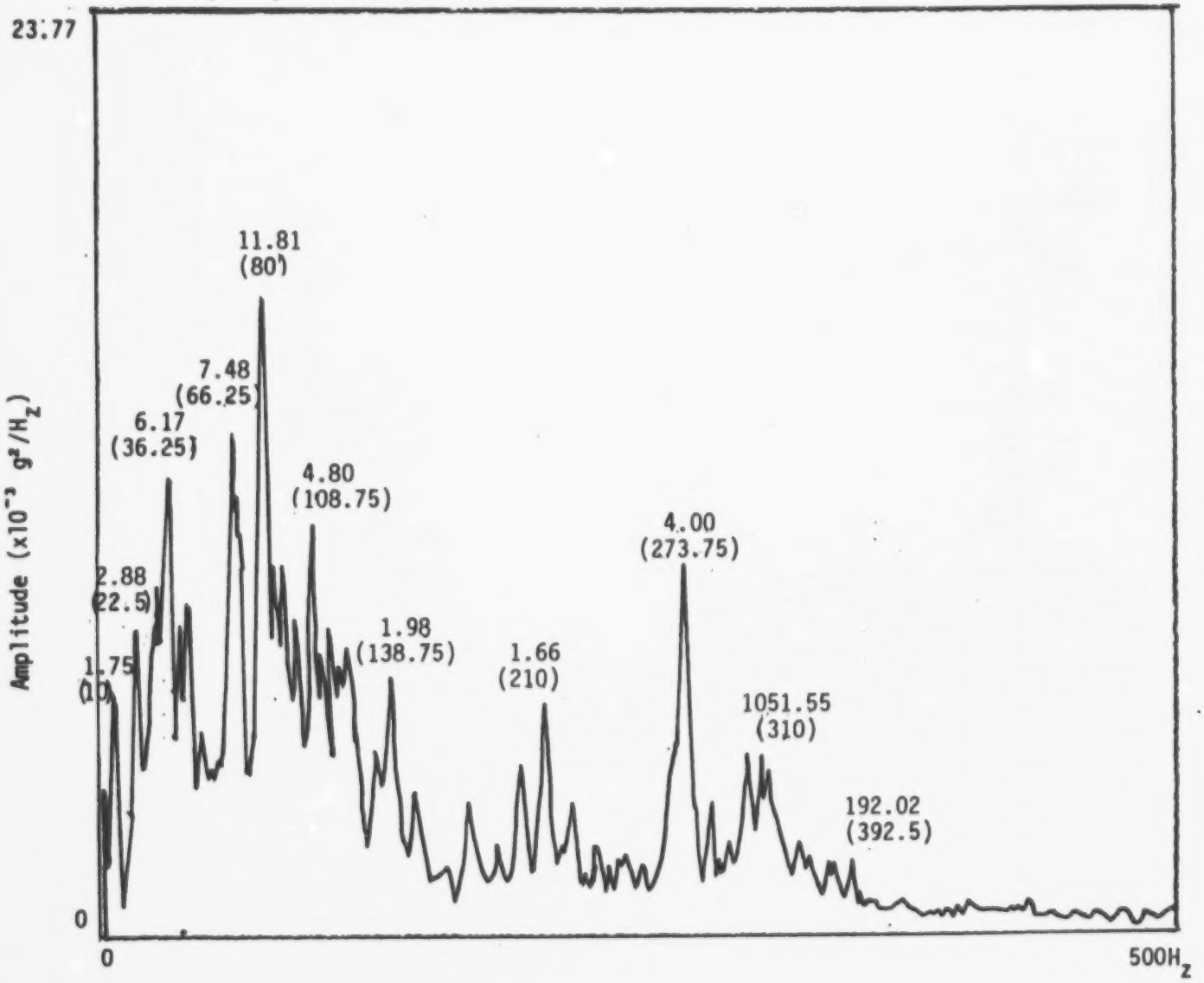


FIGURE 6.18a

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING HEAD-ON(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Sensor : BOW SWAY
Frequency: 50
File Name: F81y0
Test Time:FEB 8 1981 (02:23)
Calibration: 1.1940 (g'/v)
Sen.Range: .200(v)

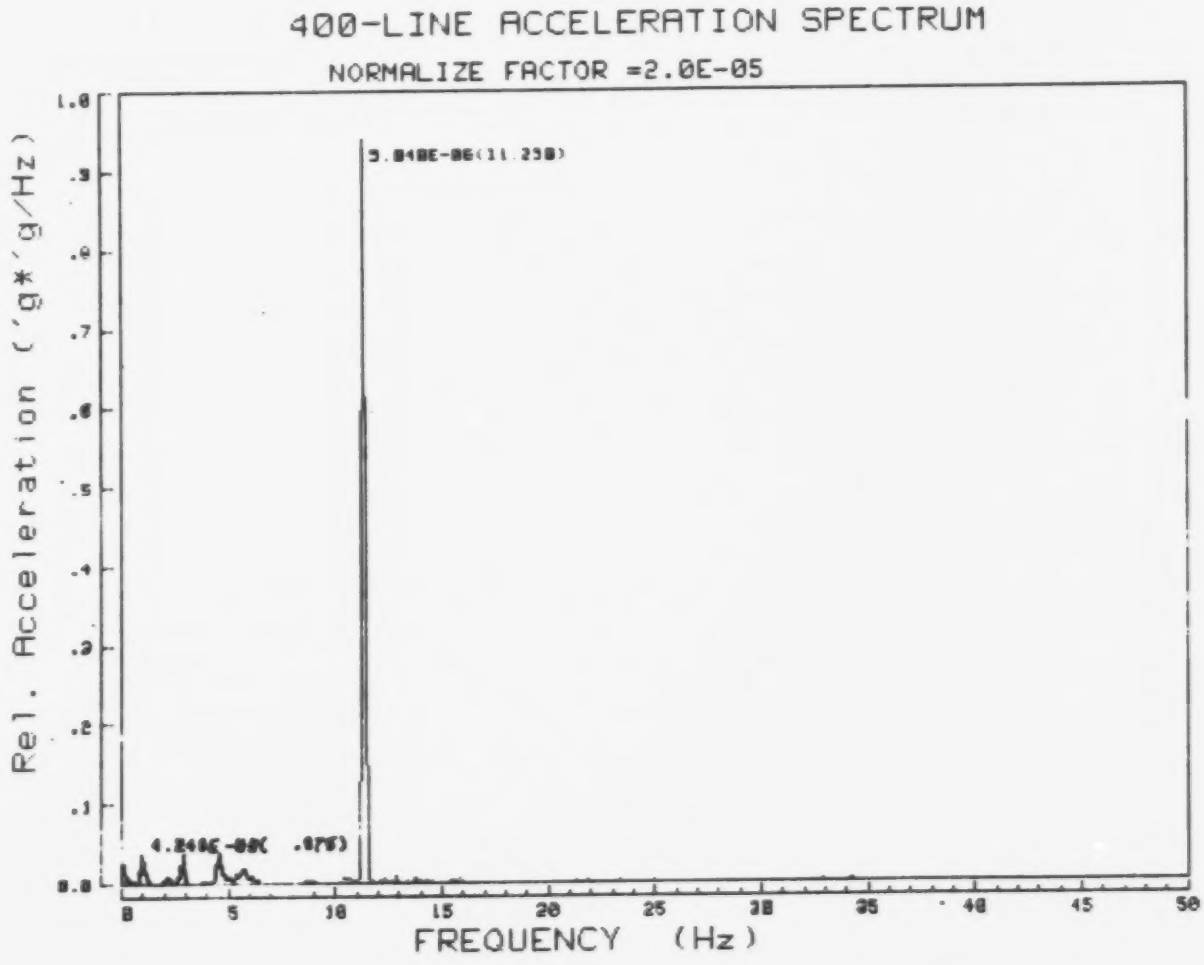


FIGURE 6.18b

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING HEAD-ON(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Sensor : BOW HEAVE
Frequency: 50
File Name: F81z0
Test Time:FEB 8 1981 (02:23)
Calibration: 1.2500 (g'/v)
Sen.Range: .200(v)

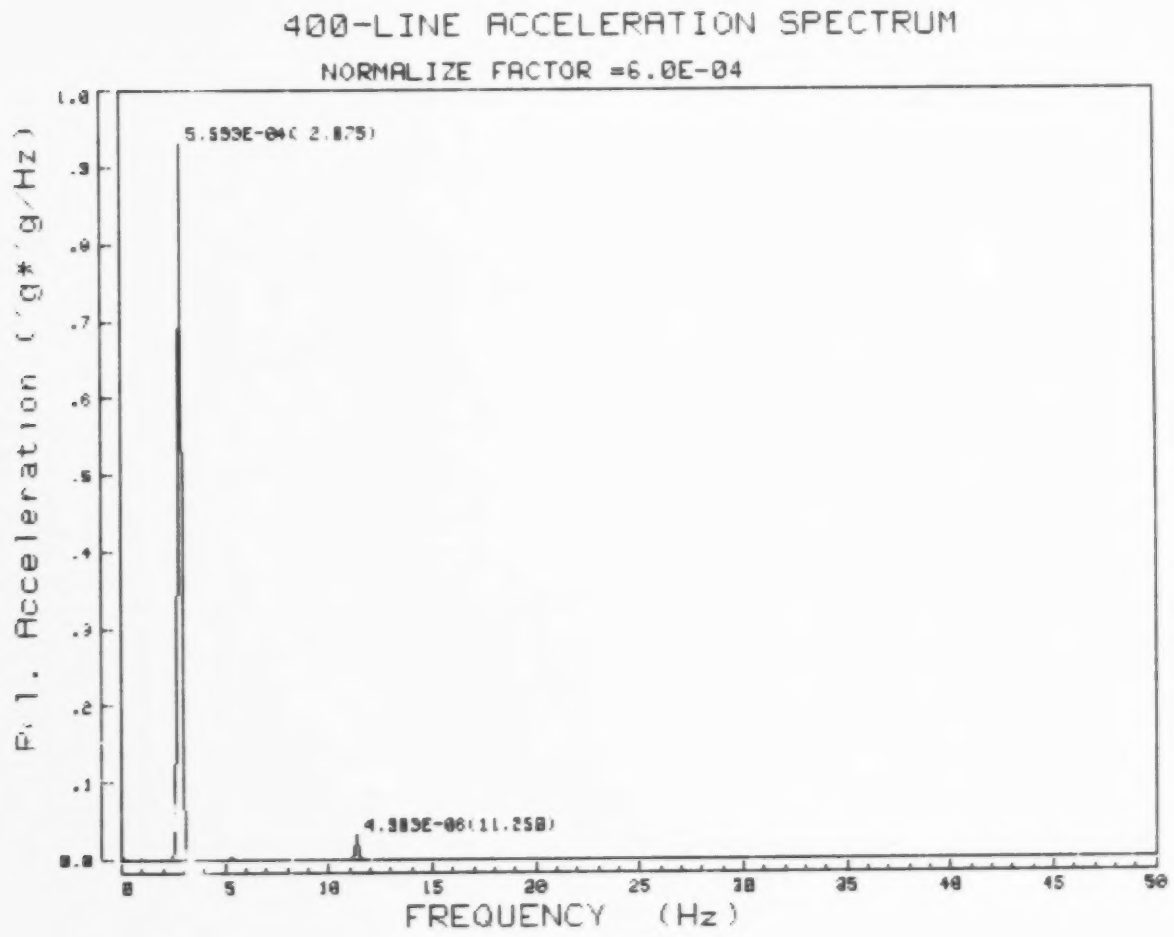


FIGURE 6.18c

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING HEAD-ON(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Test Time:FEB 8 1981 (02:23)
Sensor : ACC. 4X
Calibration: .9591 (g'/v)
Frequency: 50
Sen.Range: .100(v)
File Name: F84x0

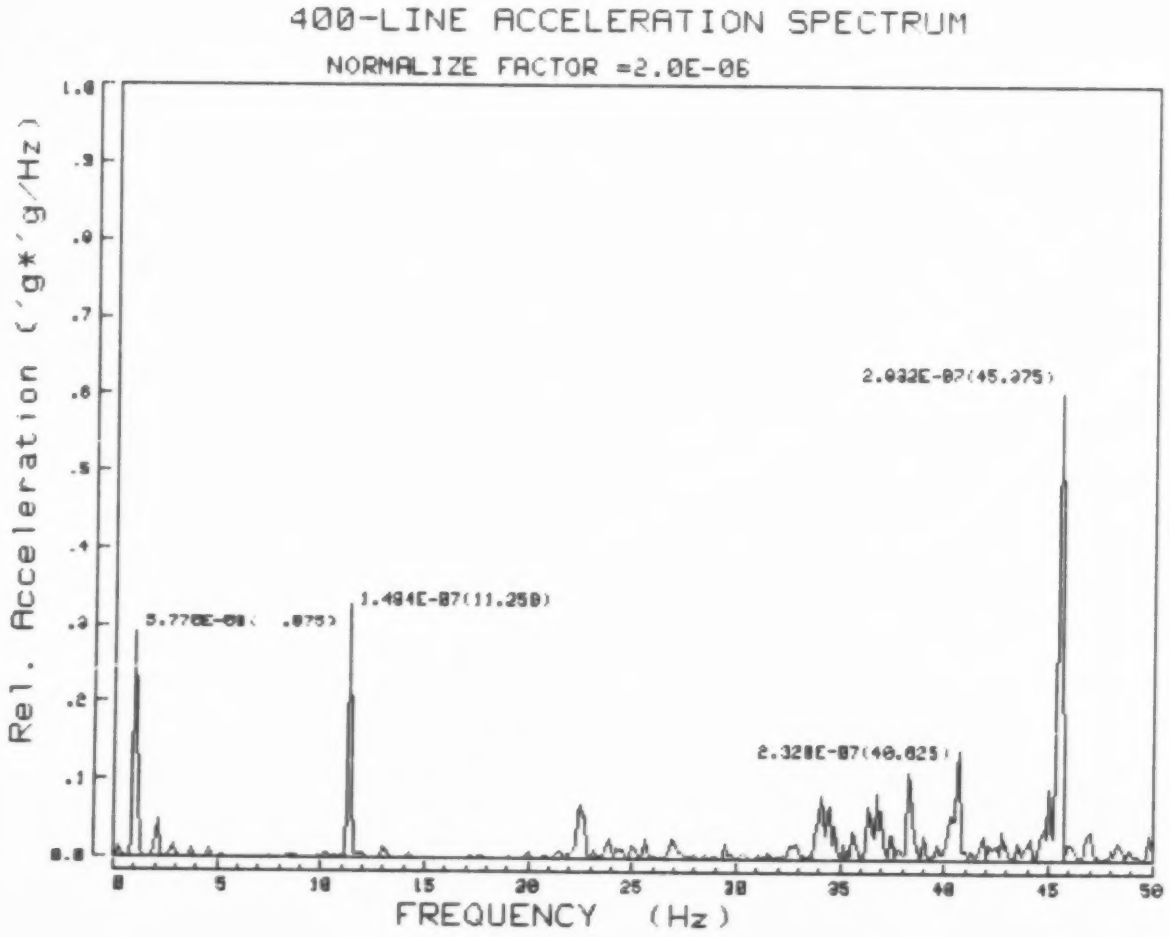


FIGURE 6.18d

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING HEAD-ON(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Sensor : ACC. 4Y
Frequency: 5
File Name: F84y0
Test Time:FEB 8 1981 (02:23)
Calibration: .9547 (g'/v)
Sen.Range: .200(v)

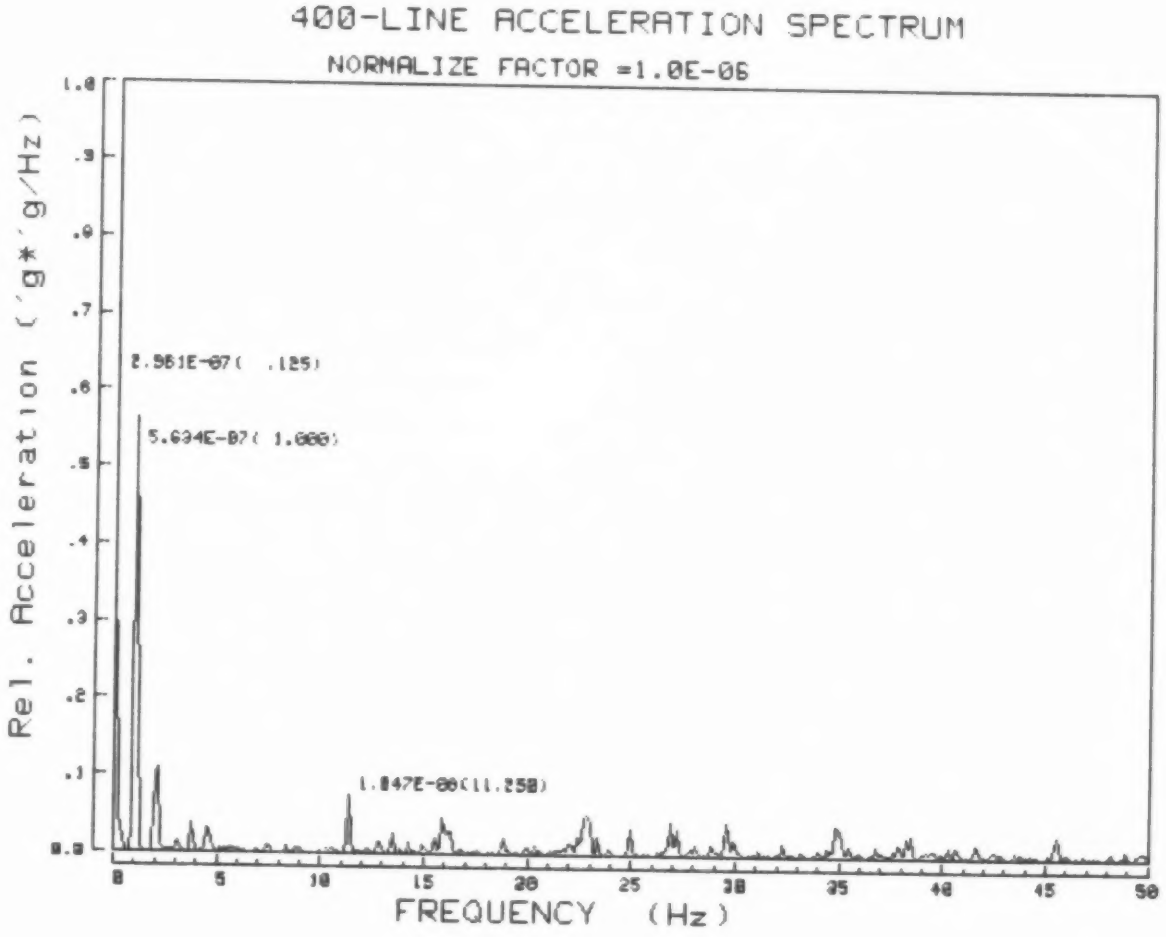


FIGURE 6.18e

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING HEAD-ON(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Sensor : ACC. 4Z
Frequency: 50
File Name: F84z0
Test Time:FEB 8 1981 (02:23)
Calibration: .9603 (g'/v)
Sen.Range: .200(v)

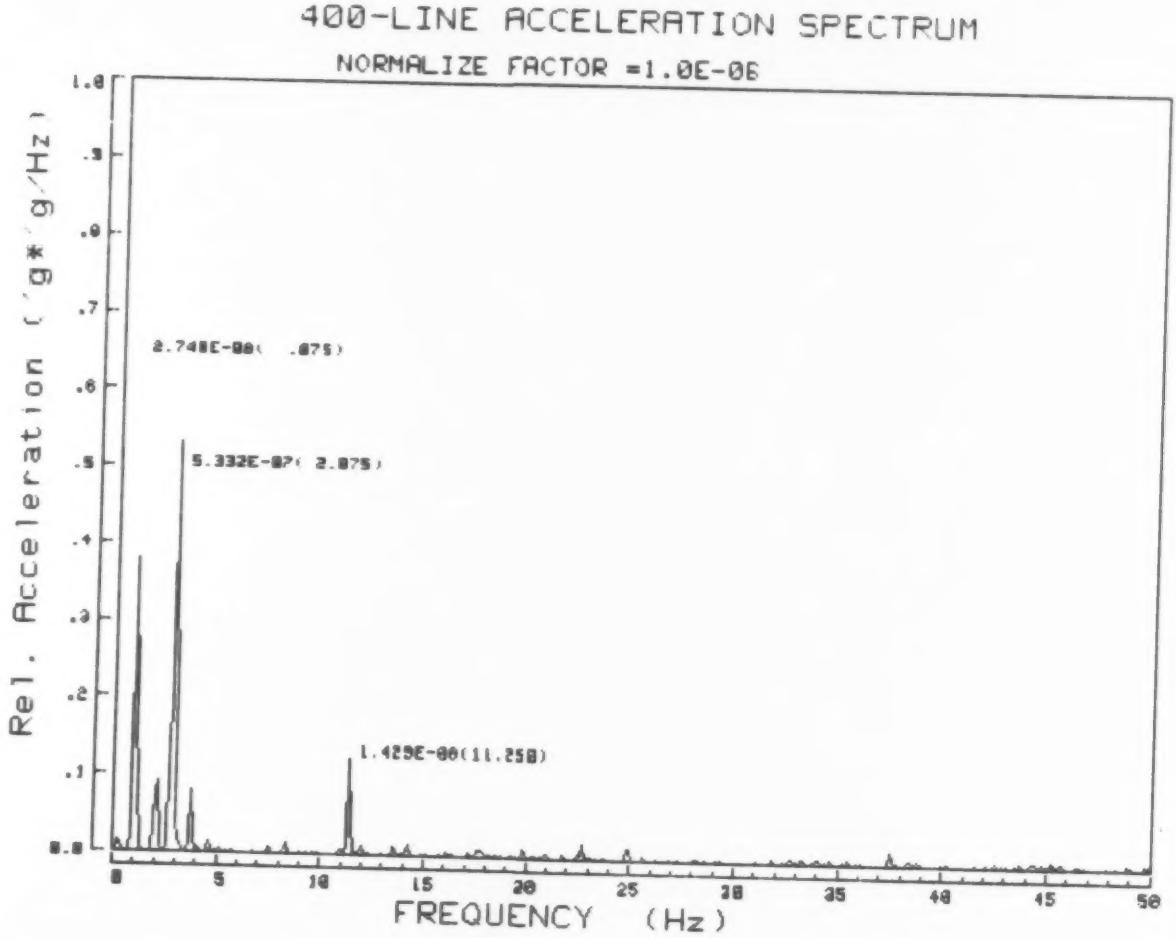


FIGURE 6.18f

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING HEAD-ON(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Sensor : ACC. 7X
Frequency: 50
File Name: F87x0
Test Time:FEB 8 1981 (02:23)
Calibration: 1.1834 (g'/v)
Sen.Range: .500(v)

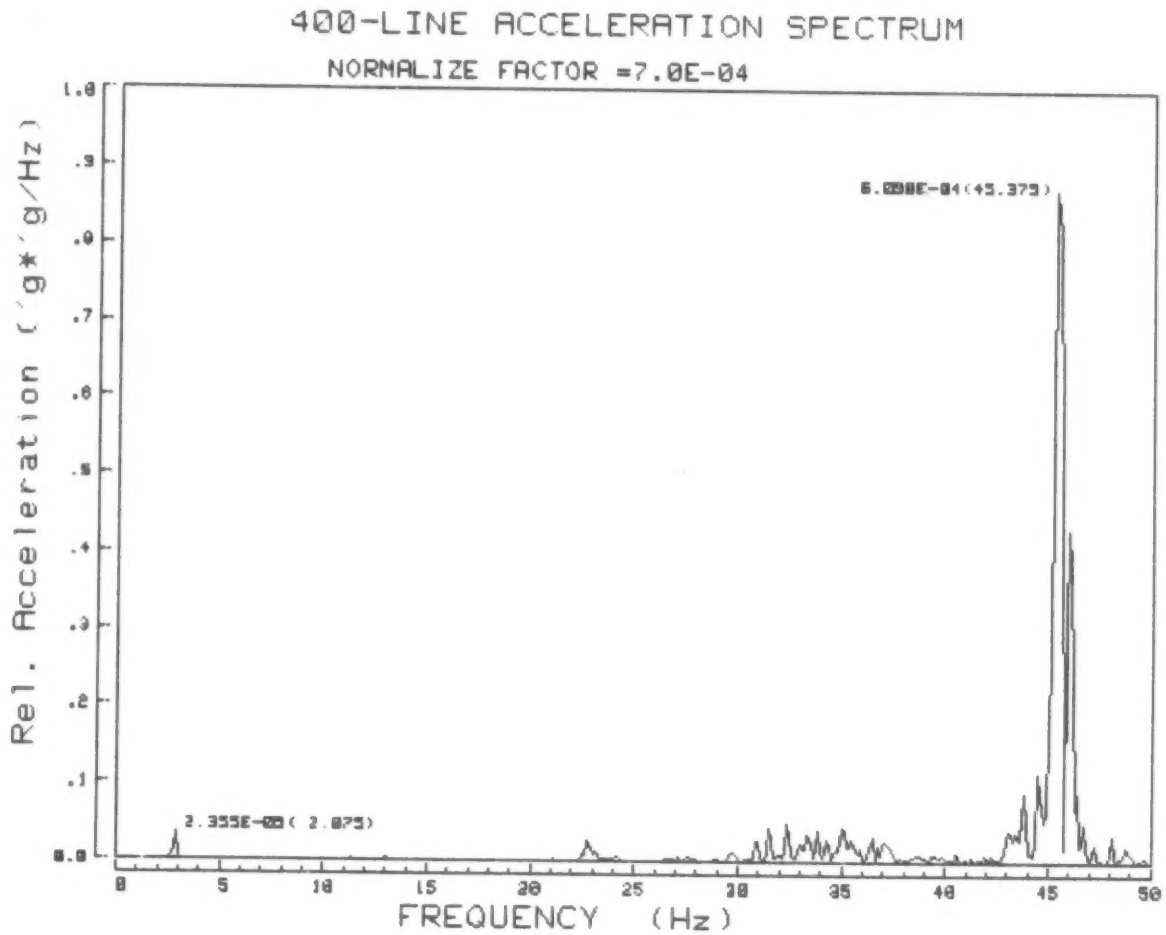


FIGURE 6.18g

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING HEAD-ON(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Sensor : ACC. 7Y
Frequency: 50
File Name: F87y0
Test Time:FEB 8 1981 (02:23)
Calibration: 1.2270 (g'/v)
Sen.Range: .500(v)

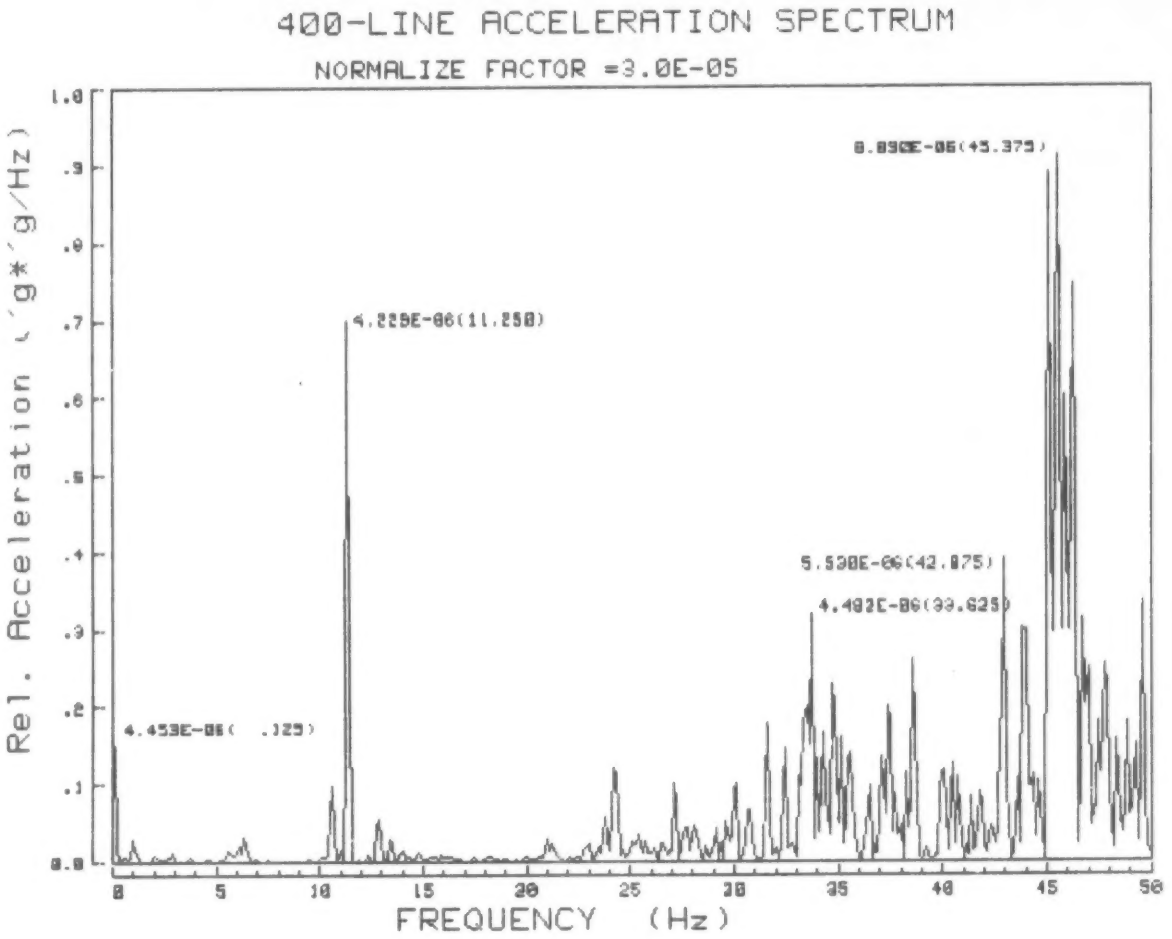


FIGURE 6.18h

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTEPPPETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING HEAD-ON(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Sensor : ACC. 7Z
Frequency: 50
File Name: F87z0
Test Time:FEB 8 1981 (02:23)
Calibration: 1.2345 (g'/v)
Sen.Range: .500(v)

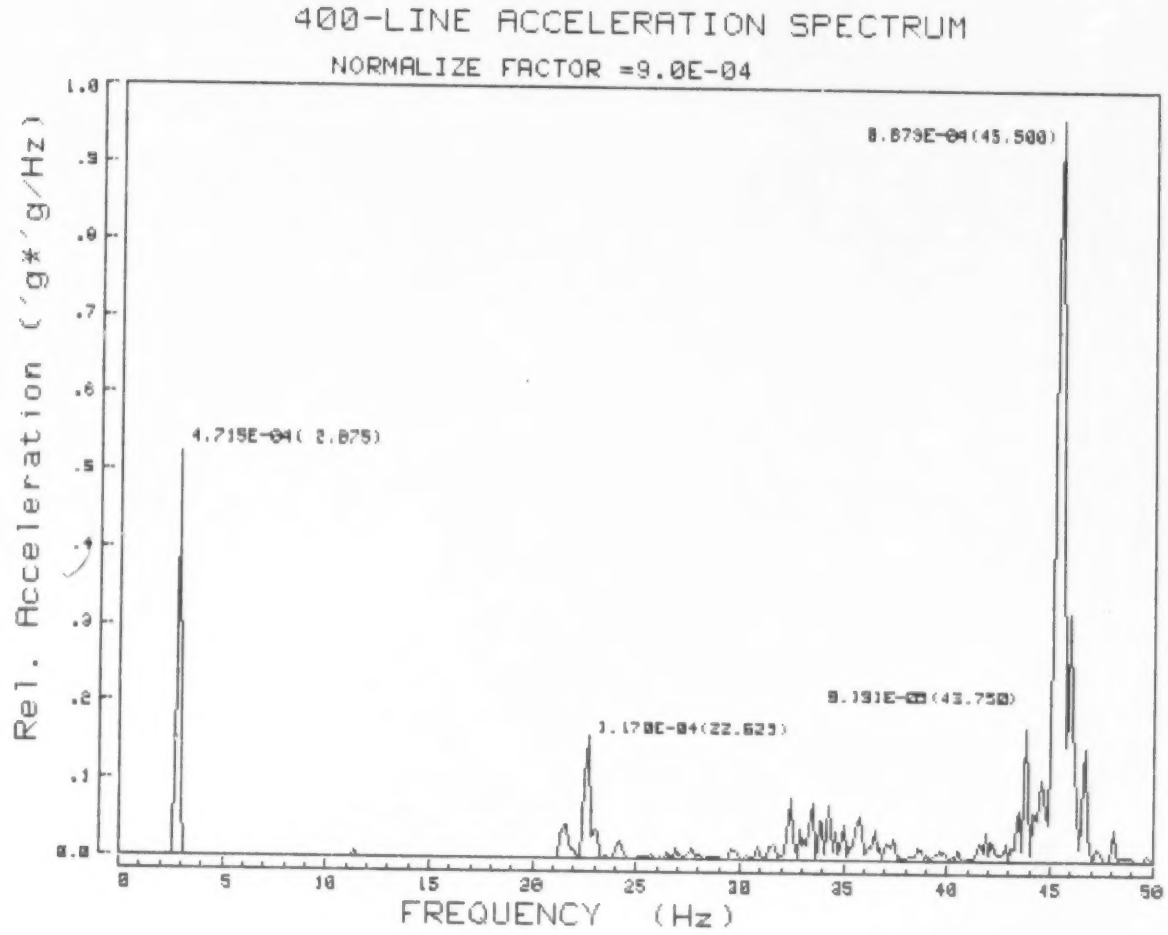


FIGURE 6.19a

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S. TEST - 2' L.I. OBLIQUE B/2 PORT(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Sensor : BOW SWAY
Frequency: 50
File Name: F81y2
Test Time:FEB 8 1981 (23:50)
Calibration: 1.1940 (g'/v)
Sen.Range: .100(v)

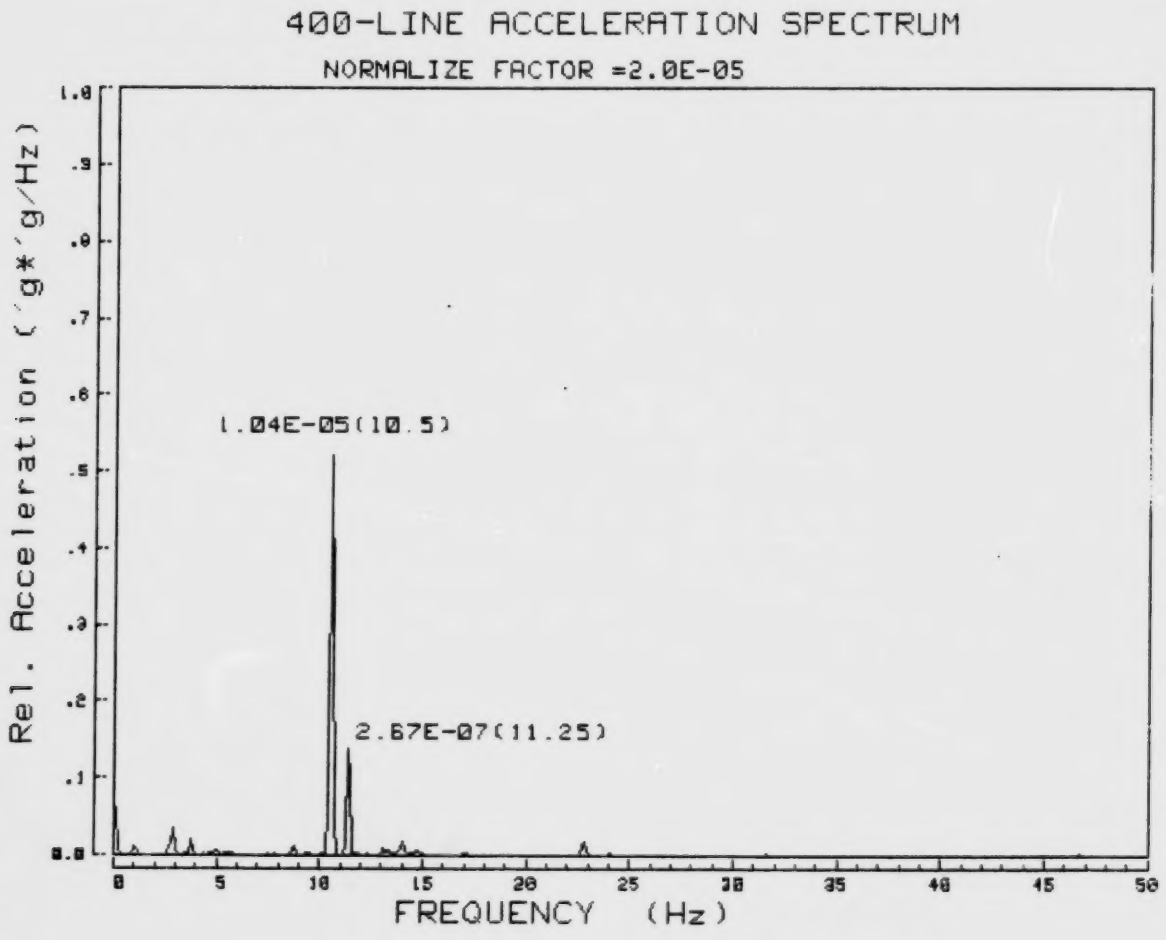


FIGURE 6.19b

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S. TEST - 2' L.I. OBLIQUE B/2 PORT(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Test Time:FEB 8 1981 (23:50)
Sensor : BOW HEAVE
Calibration: 1.2500 (g'/v)
Frequency: 50
Sen.Range: .200(v)
File Name: F81z2

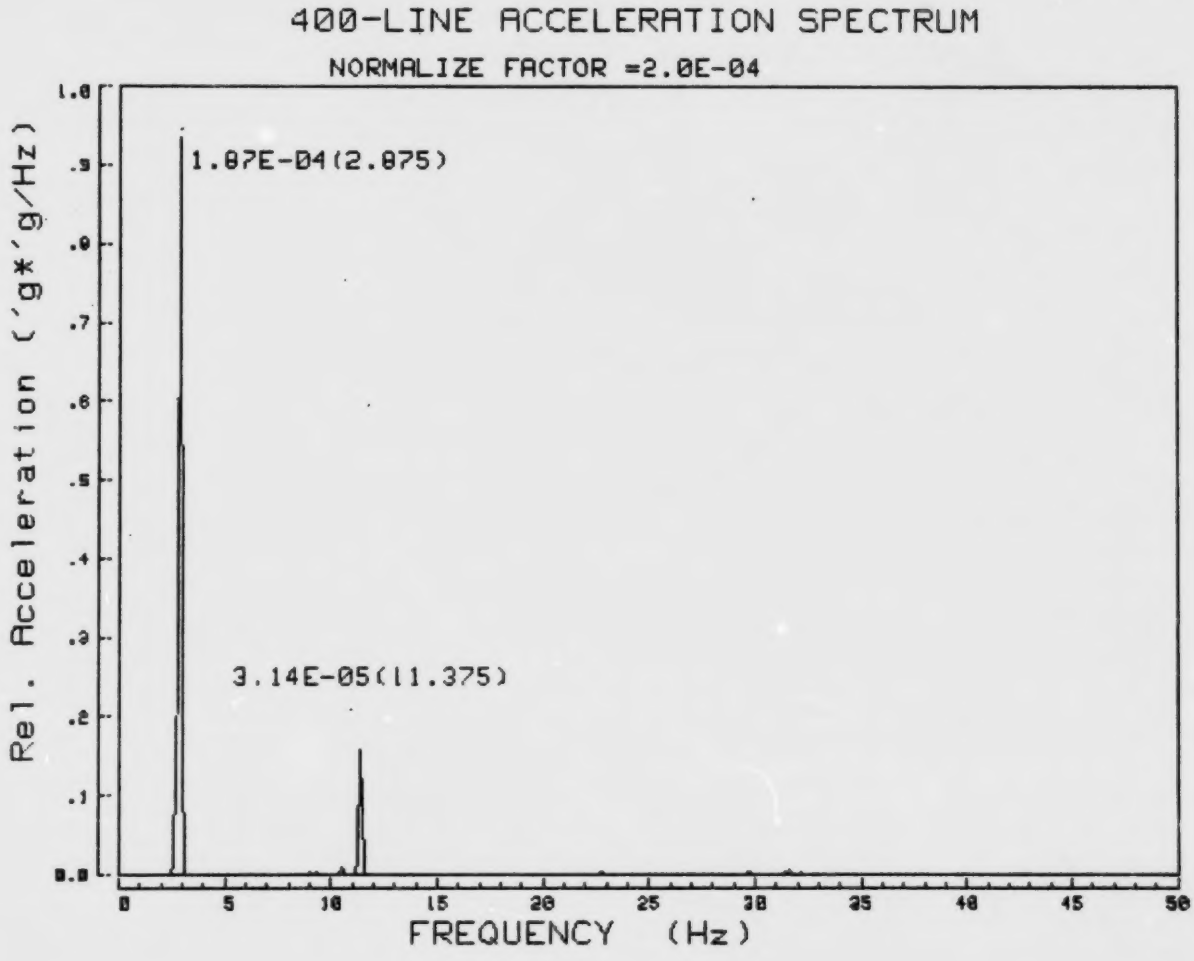


FIGURE 6.19c

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S. TEST - 2' L.I. OBLIQUE B/2 PORT(BEFORE IMPACT)
Vessel : USCGC POLAR SEA Test Time:FEB 8 1981 (23:50)
Sensor : ACC. 4X Calibration: .9591 (g'/v)
Frequency: 50 Sen.Range: .100(v)
File Name: F84x2

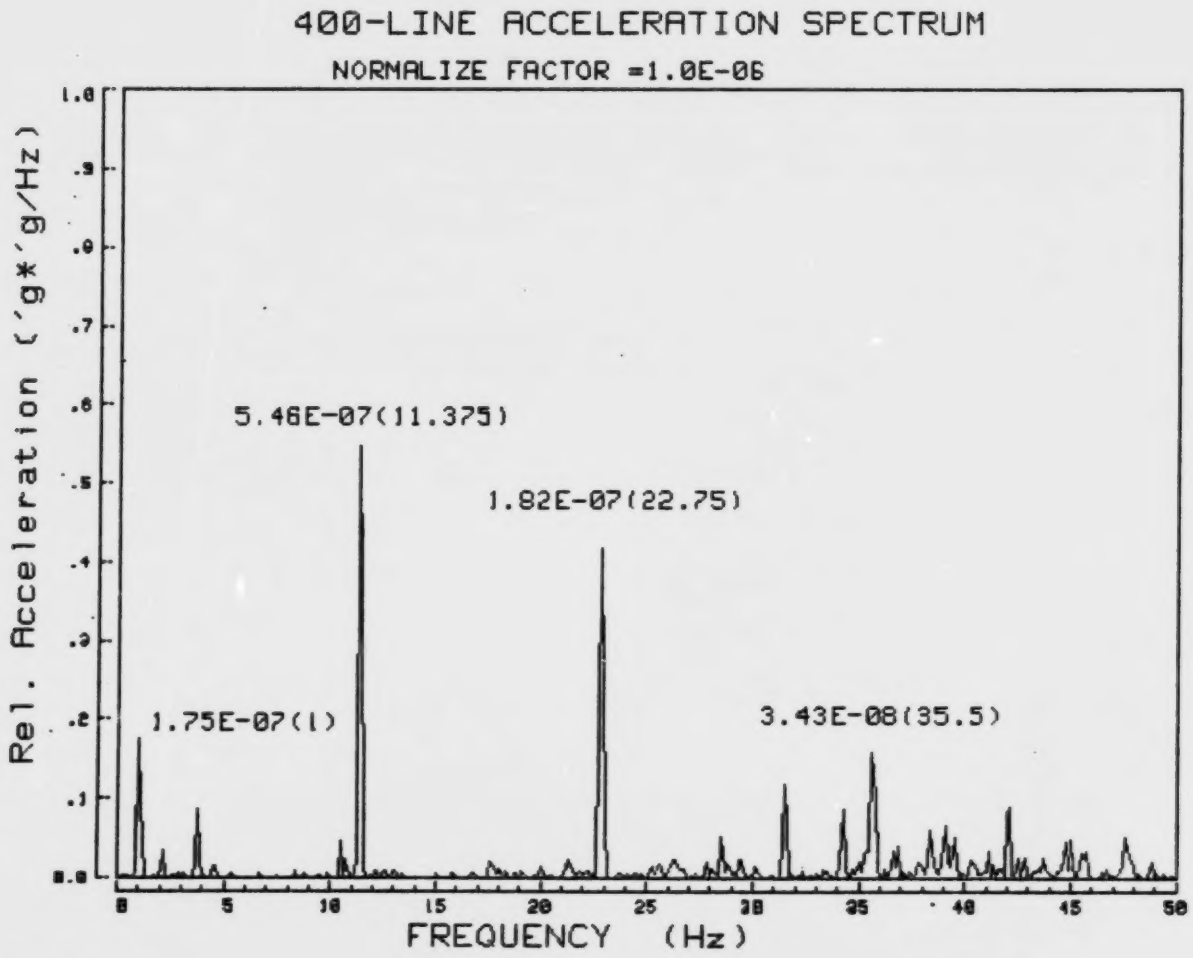


FIGURE 6.19d

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S. TEST - 2' L.I. OBLIQUE B/2 PORT(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Sensor : ACC. 4Y
Frequency: 50
File Name: F84y2
Test Time:FEB 8 1981 (23:50)
Calibration: .9547 (g'/v)
Sen.Range: .200(v)

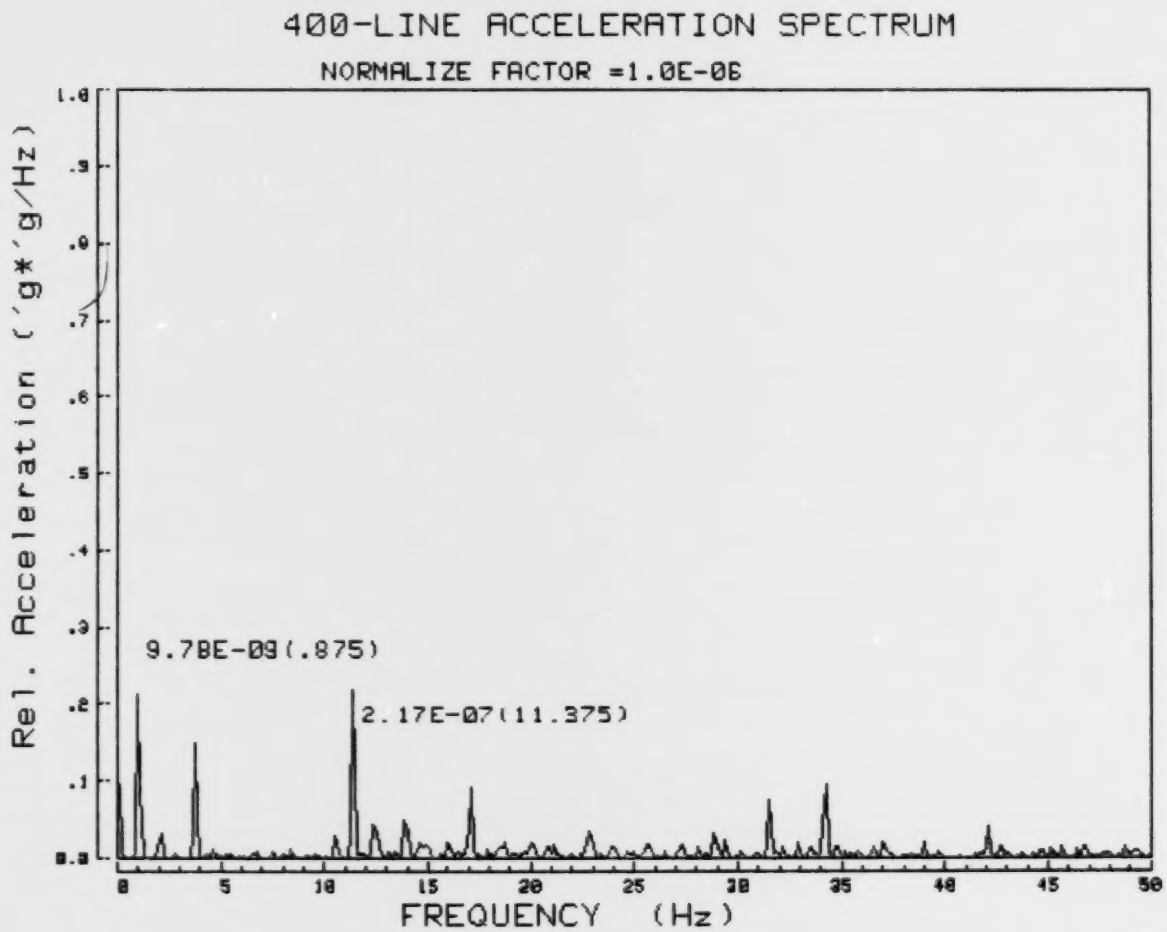


FIGURE 6.19e

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S. TEST - 2' L.I. OBLIQUE B/2 PORT(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Test Time:FEB 8 1981 (23:50)
Sensor : ACC. 4Z
Calibration: .9603 (g'/v)
Frequency: 50
Sen.Range: .200(v)
File Name: F84z2

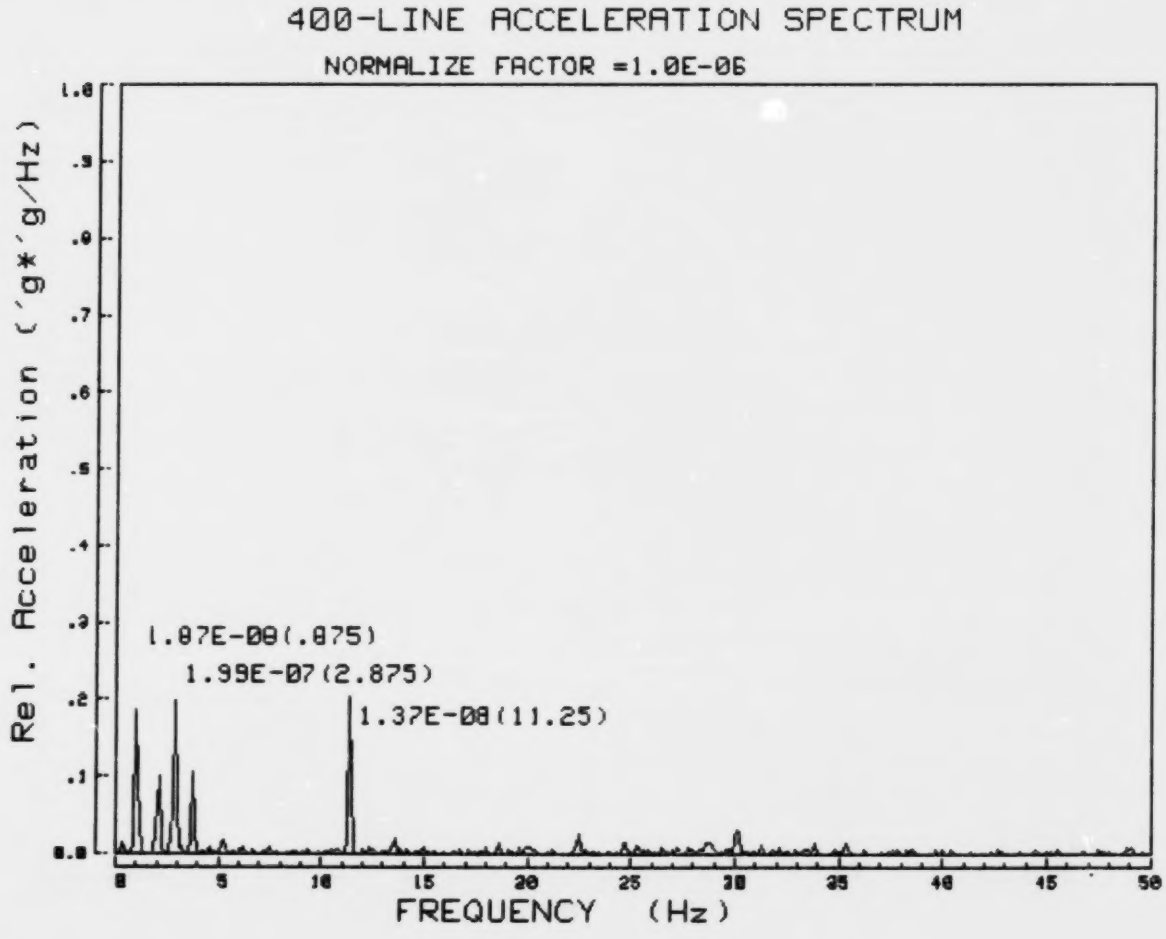


FIGURE 6.19f

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S. TEST - 2' L.I. OBLIQUE B/2 PORT(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Test Time:FEB 8 1981 (23:50)
Sensor : ACC. 7X
Calibration: 1.1834 (g'/v)
Frequency: 50
Sen.Range: .500(v)
File Name: F87x2

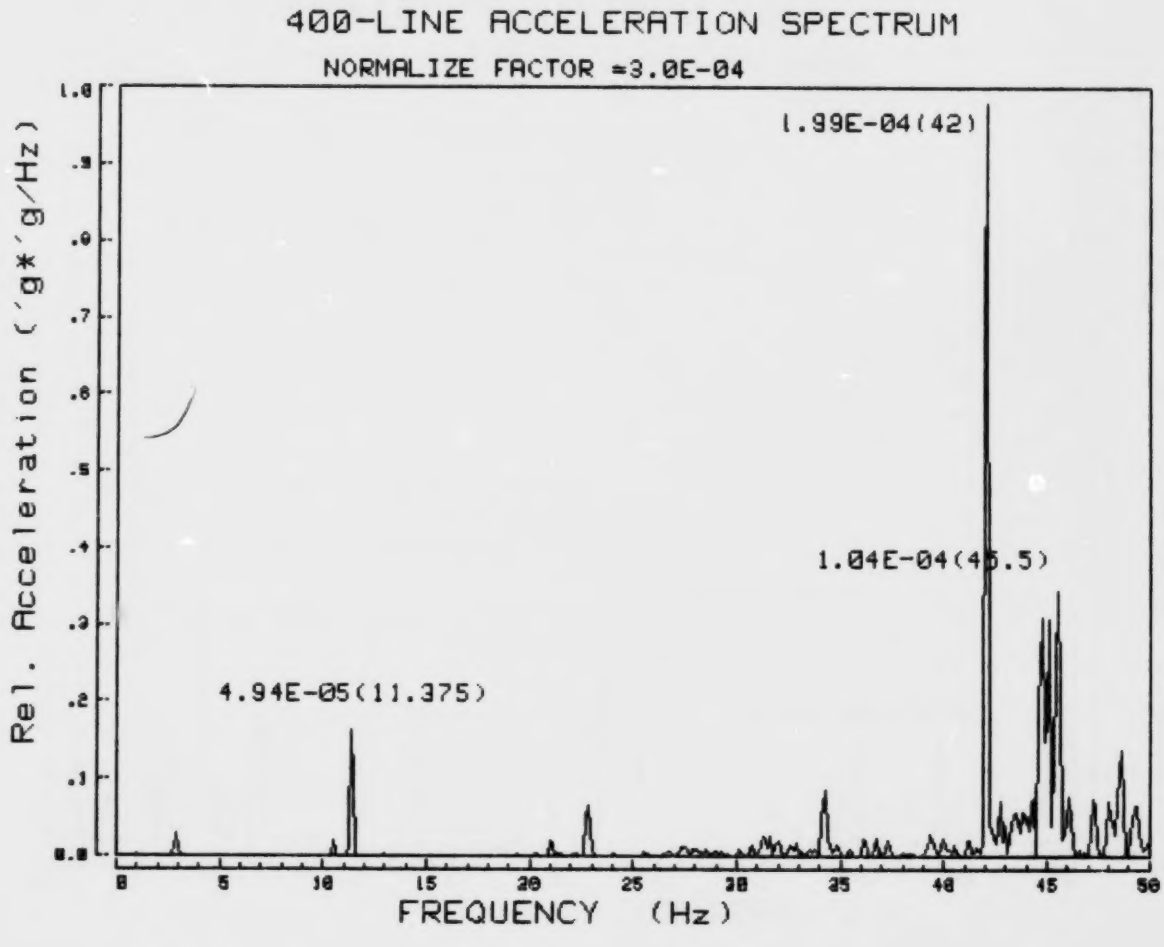


FIGURE 6.19g

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S. TEST - 2' L.I. OBLIQUE B/2 PORT(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Test Time:FEB 8 1981 (23:50)
Sensor : ACC. 7Y
Calibration: 1.2270 (g'/v)
Frequency: 50
Sen.Range: .500(v)
File Name: F87y2

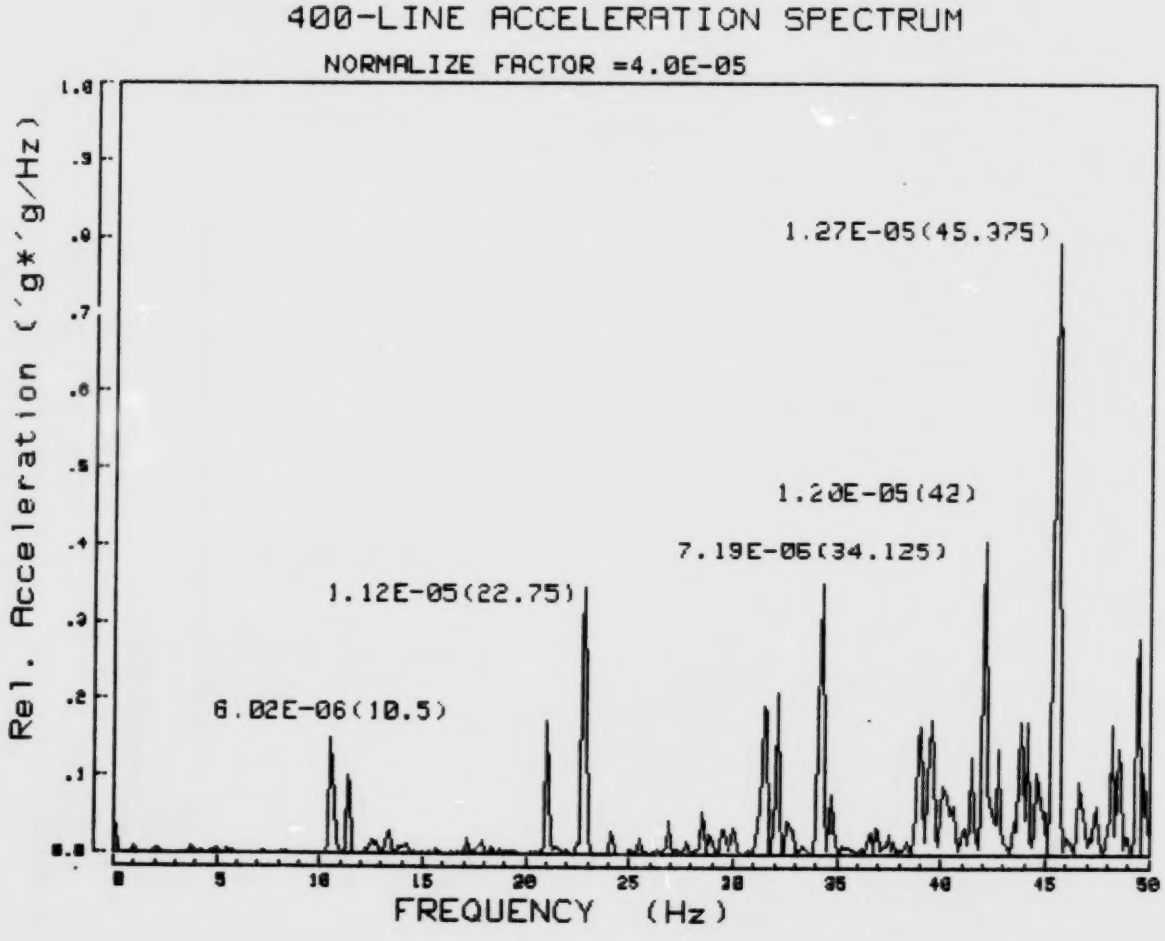
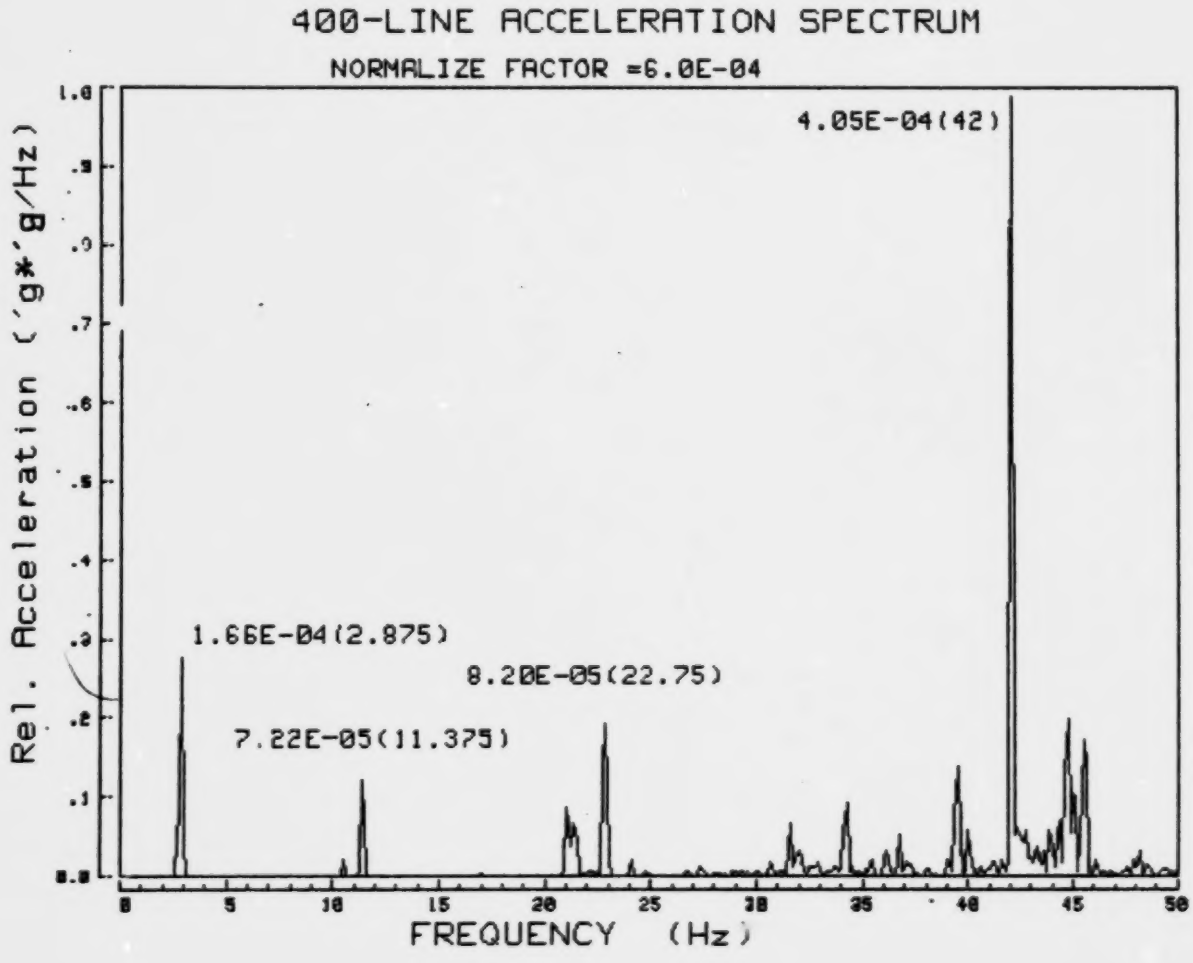


FIGURE 6.19h

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S. TEST - 2' L.I. OBLIQUE B/2 PORT(BEFORE IMPACT)
Vessel : USCGC POLAR SEA
Test Time:FEB 8 1981 (23:50)
Sensor : ACC. 7Z
Calibration: 1.2345 (g'/v)
Frequency: 50
Sen.Range: .500(v)
File Name: F87z2



ANNEX 7

COMPUTED FORCE SPECTRA

TEST NUMBER	DATE-TIME GROUP	ACCELERATION SPECTRA	COMPUTED FORCE SPECTRA
F8-0	02:08:02:23	Fig. 7.1a-o	Fig. 7.2a-j
F8-1	02:08:02:30		Fig. 7.3a-j
F8-2	02:08:23:50		Fig. 7.4a-j
F9-0	02:09:06:09		Fig. 7.5a-j
F9-1	02:09:06:20		Fig. 7.6a-j
F9-2	02:09:06:26		Fig. 7.7a-j
F9-4	02:09:13:50		Fig. 7.8a-j
F9-5	02:09:14:00		Fig. 7.9a-j

FIGURE 7.1a

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5′ L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA
Test Time:FEB 8 1981 (02:23)
Sensor : BOW SWAY
Calibration: 1.1940 (g′/v)
Frequency: 50
Sen.Range: .200(v)
File Name: F81Y1

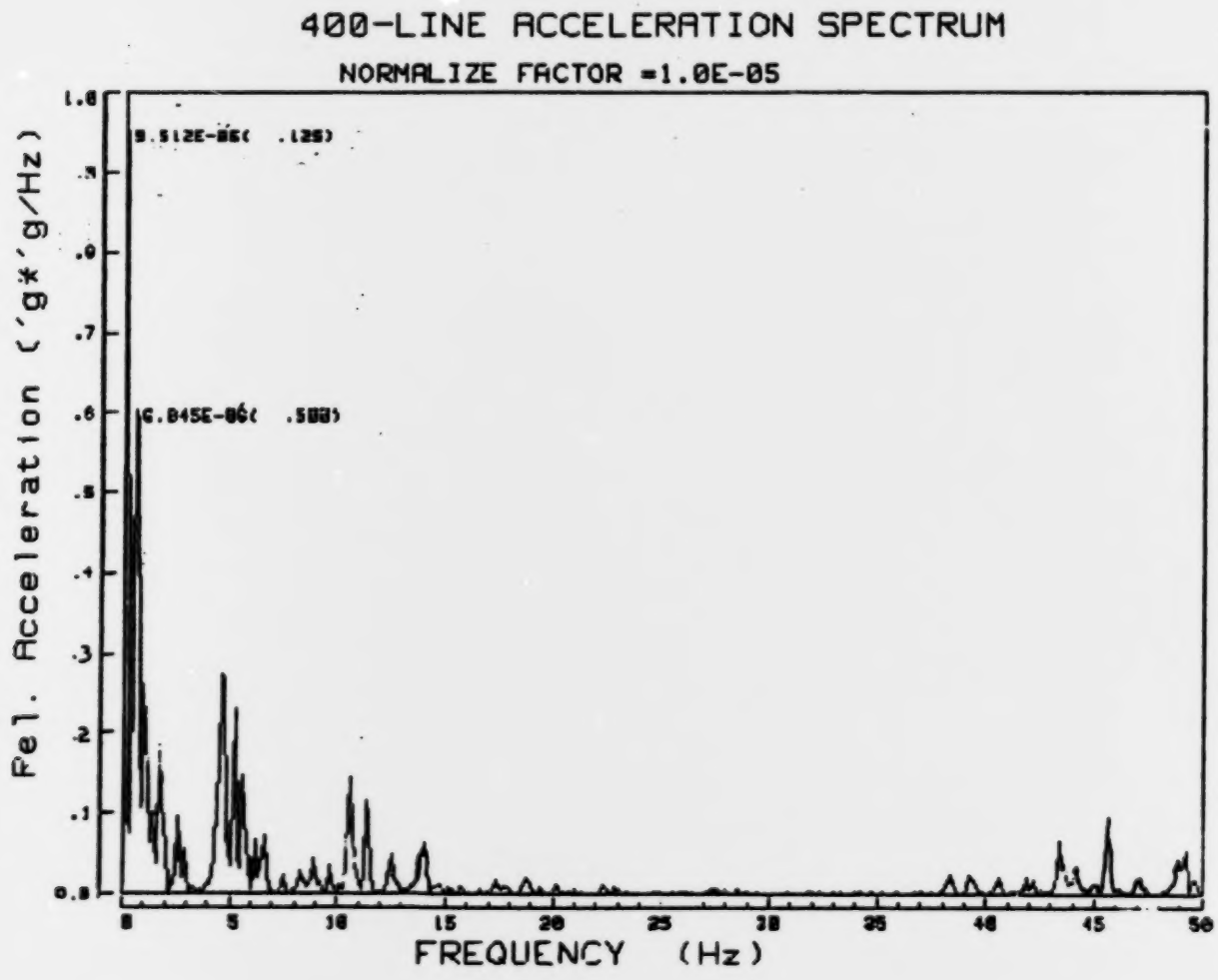


FIGURE 7.1b

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5′ L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA
Sensor : BOW HEAVE
Frequency: 50
File Name: F81Z0
Test Time:FEB 8 1981 (02:23)
Calibration: 1.2500 (g′/v)
Sen.Range: .200(v)

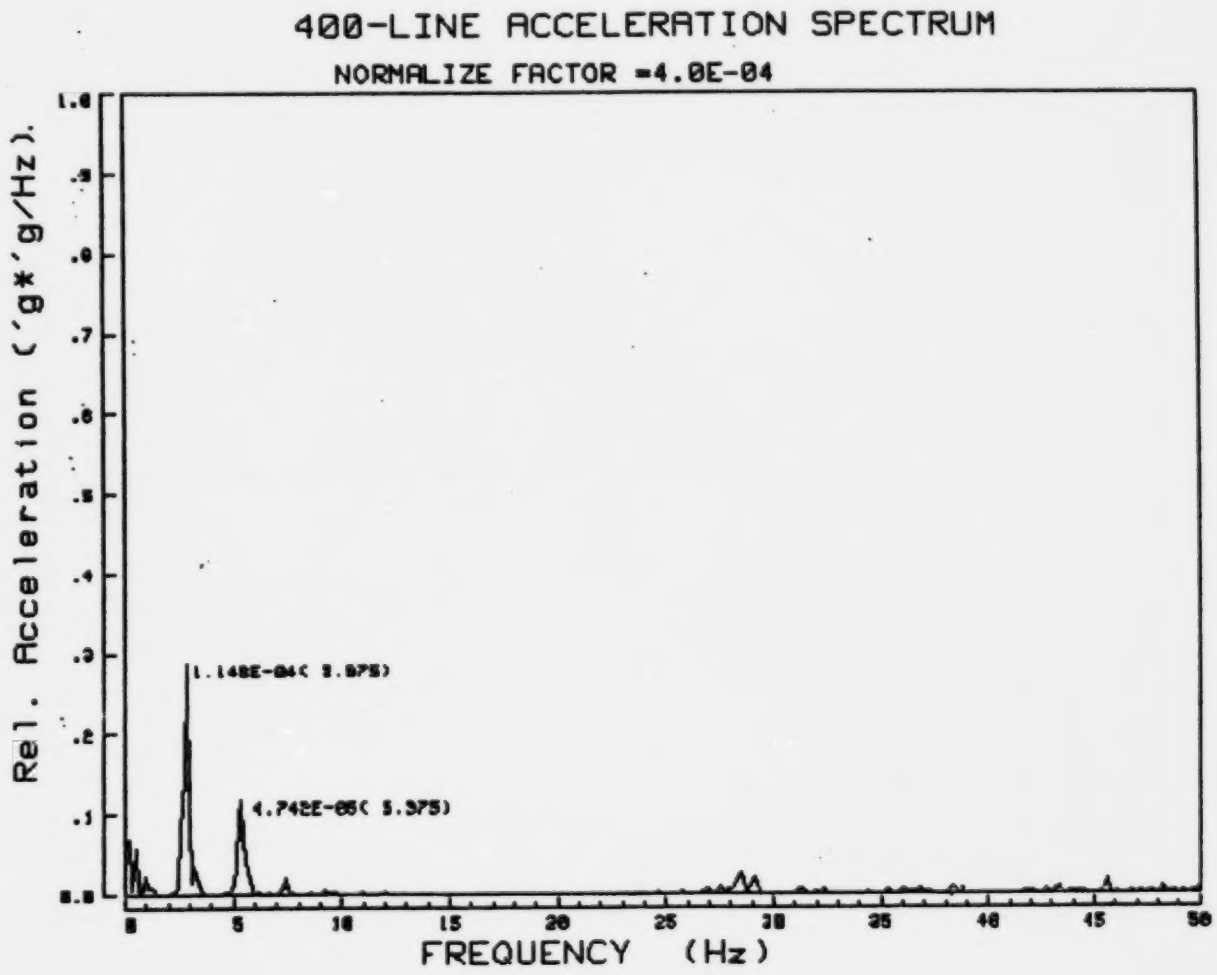


FIGURE 7.1c

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA Test Time:FEB 8 1981 (02:23)
Sensor : ACC. 2X Calibration: 1.1765 (g'/v)
Frequency: 50 Sen.Range: .200(v)
File Name: F82X0

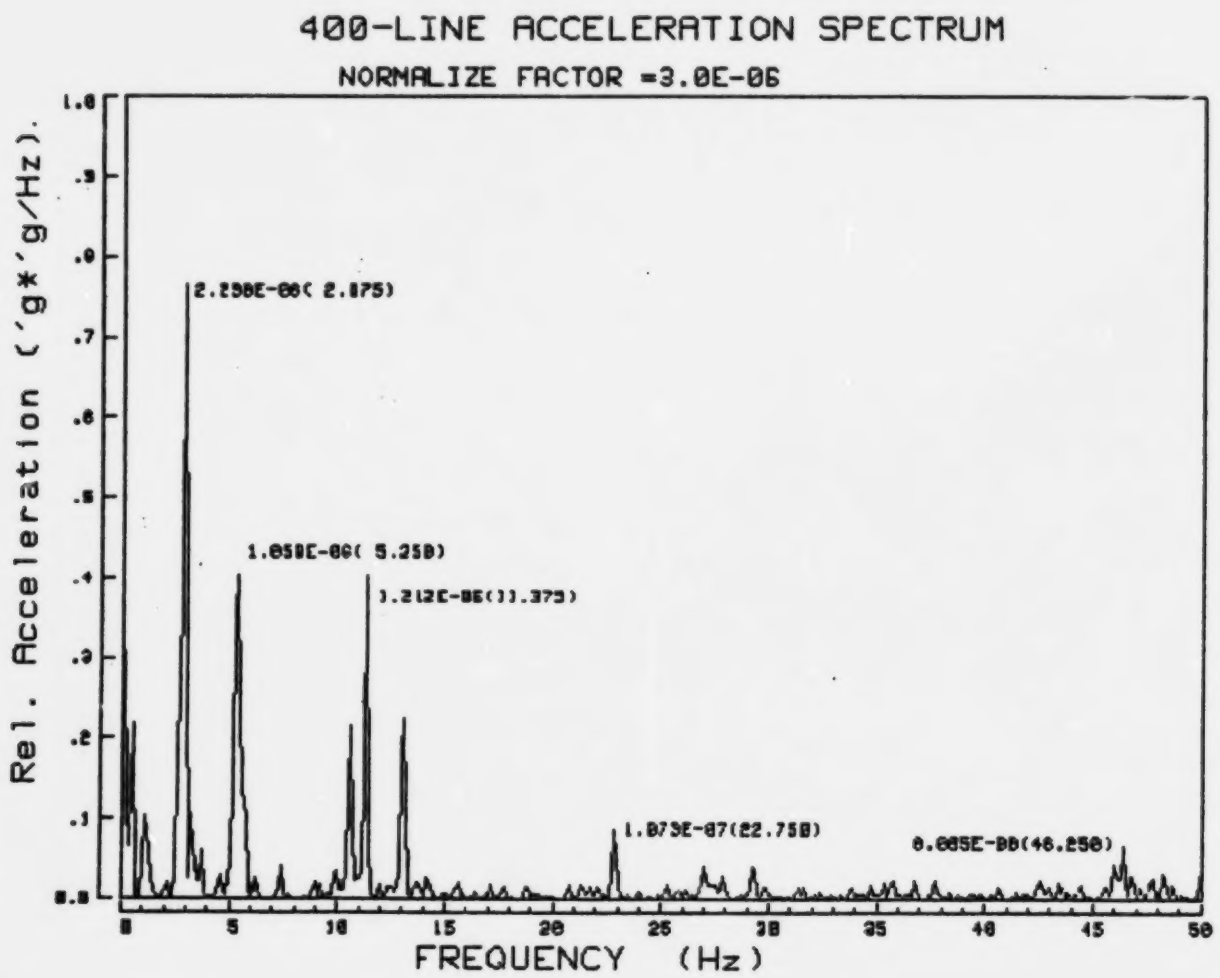


FIGURE 7.1d

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA Test Time:FEB 8 1981 (02:23)
Sensor : ACC. 2Y Calibration: 1.2739 (g'/v)
Frequency: 50 Sen.Range: .200(v)
File Name: F82Y0

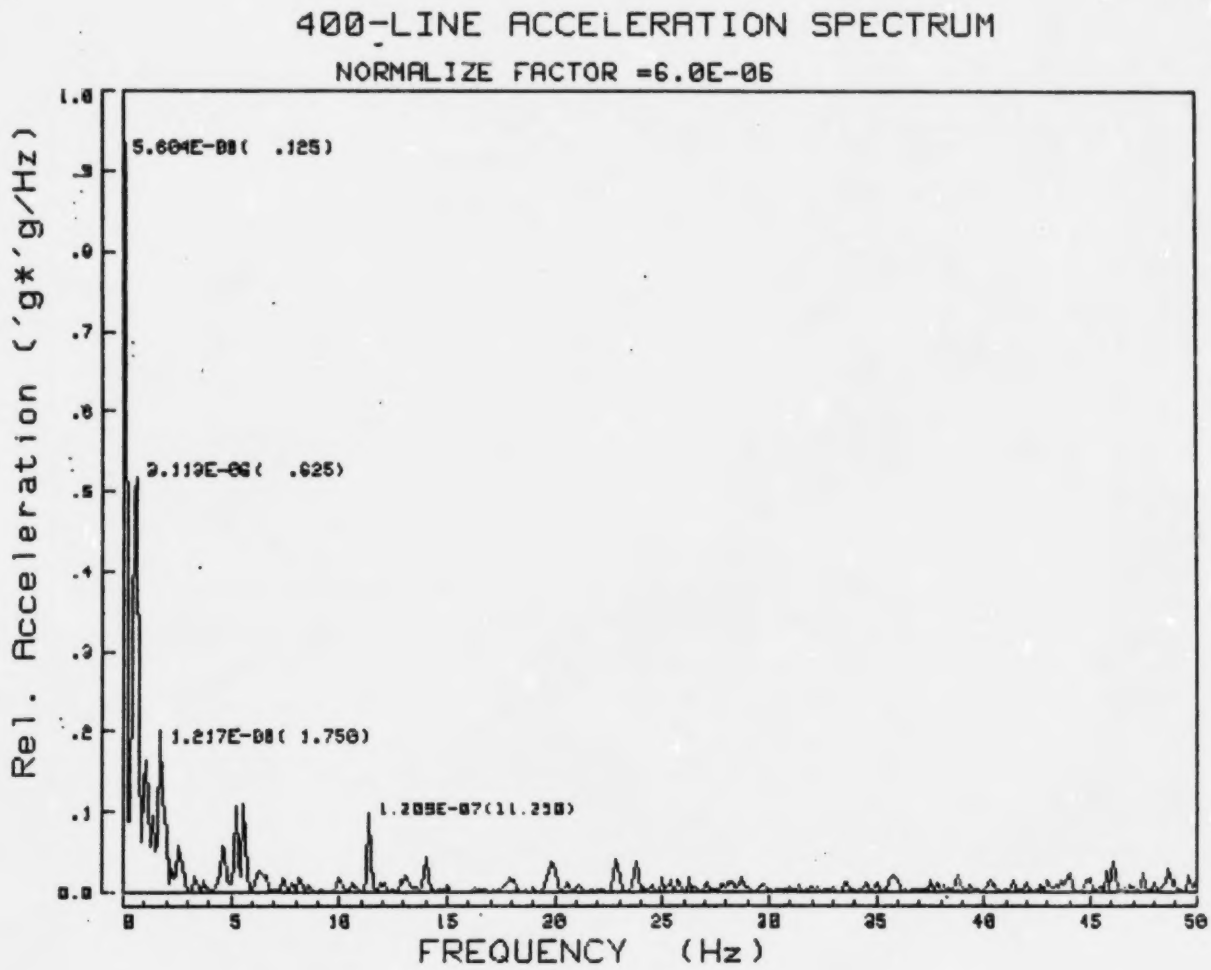


FIGURE 7.1e

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5′ L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA
Test Time:FEB 8 1981 (02:23)
Sensor : ACC. 2Z
Calibration: 1.2500 (g′/v)
Frequency: 50
Sen.Range: .200(v)
File Name: F8220

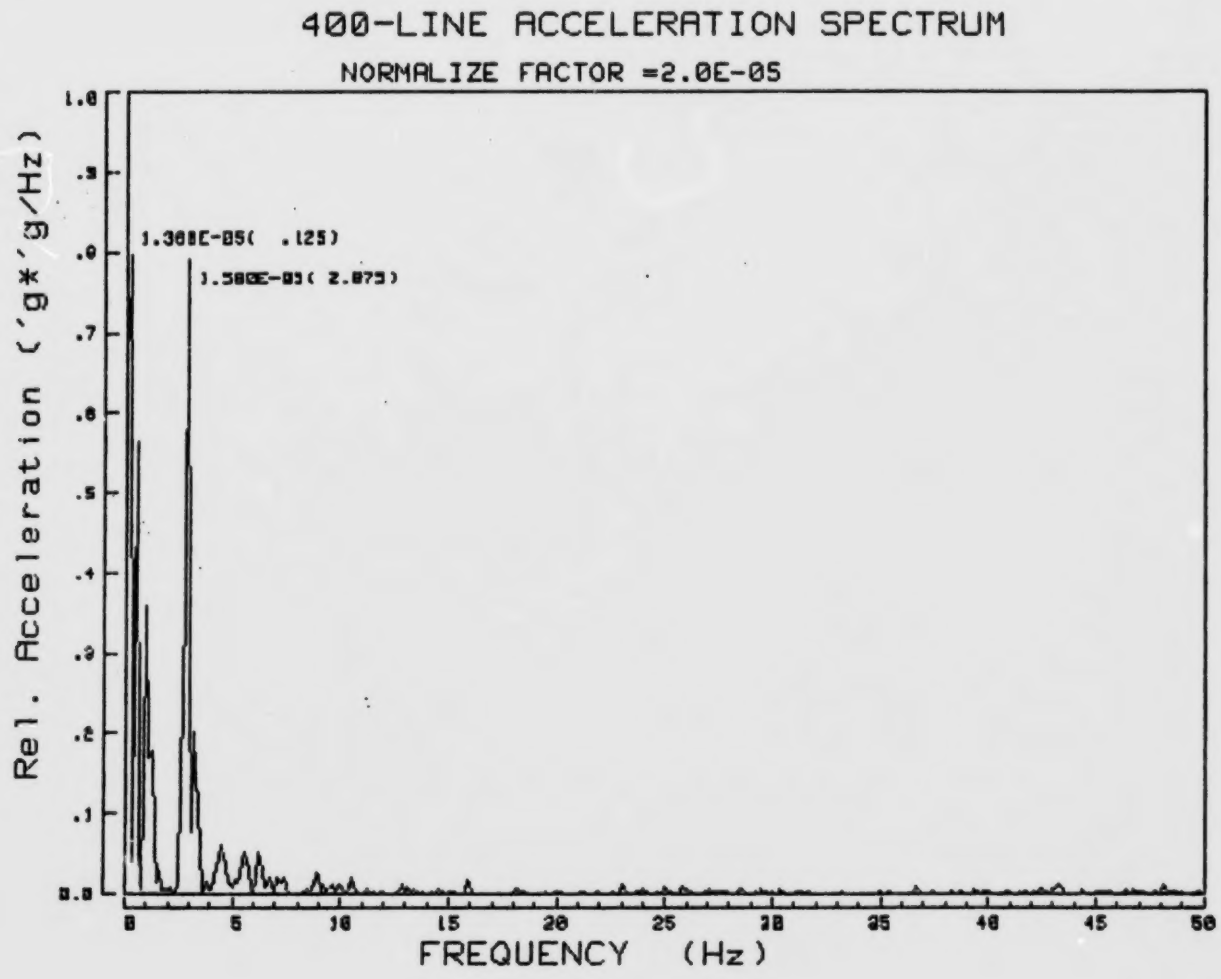


FIGURE 7.1f

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5′ L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA
Test Time:FEB 8 1981 (02:23)
Sensor : ACC. 3X
Calibration: 1.2500 (g′/v)
Frequency: 50
Sen.Range: .200(v)
File Name: F83X0

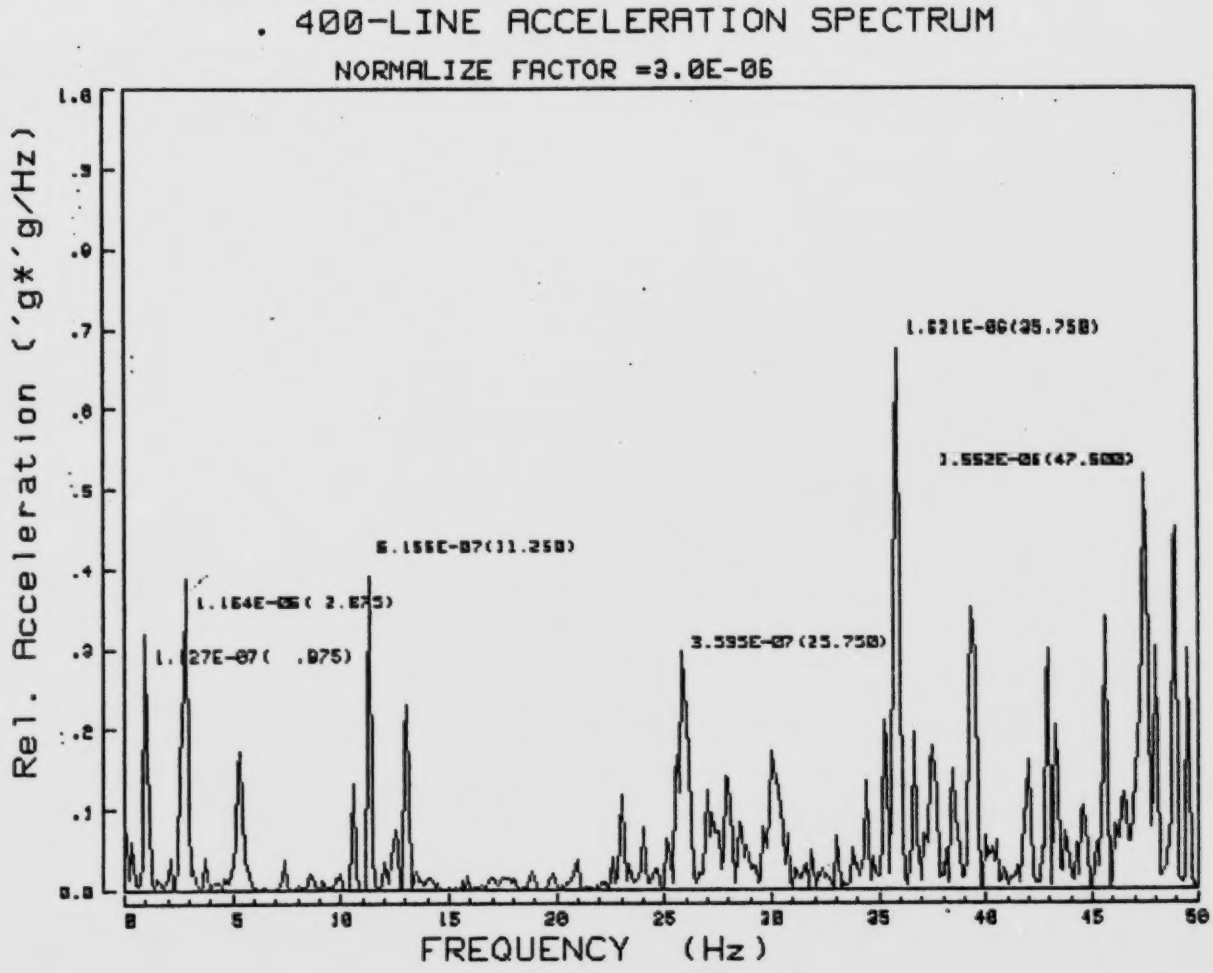


FIGURE 7.1g

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5′ L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA
Test Time:FEB 8 1981 (02:23)
Sensor : ACC. 3Y
Calibration: 1.2195 (g′/v)
Frequency: 50
Sen.Range: .200(v)
File Name: F83Y0

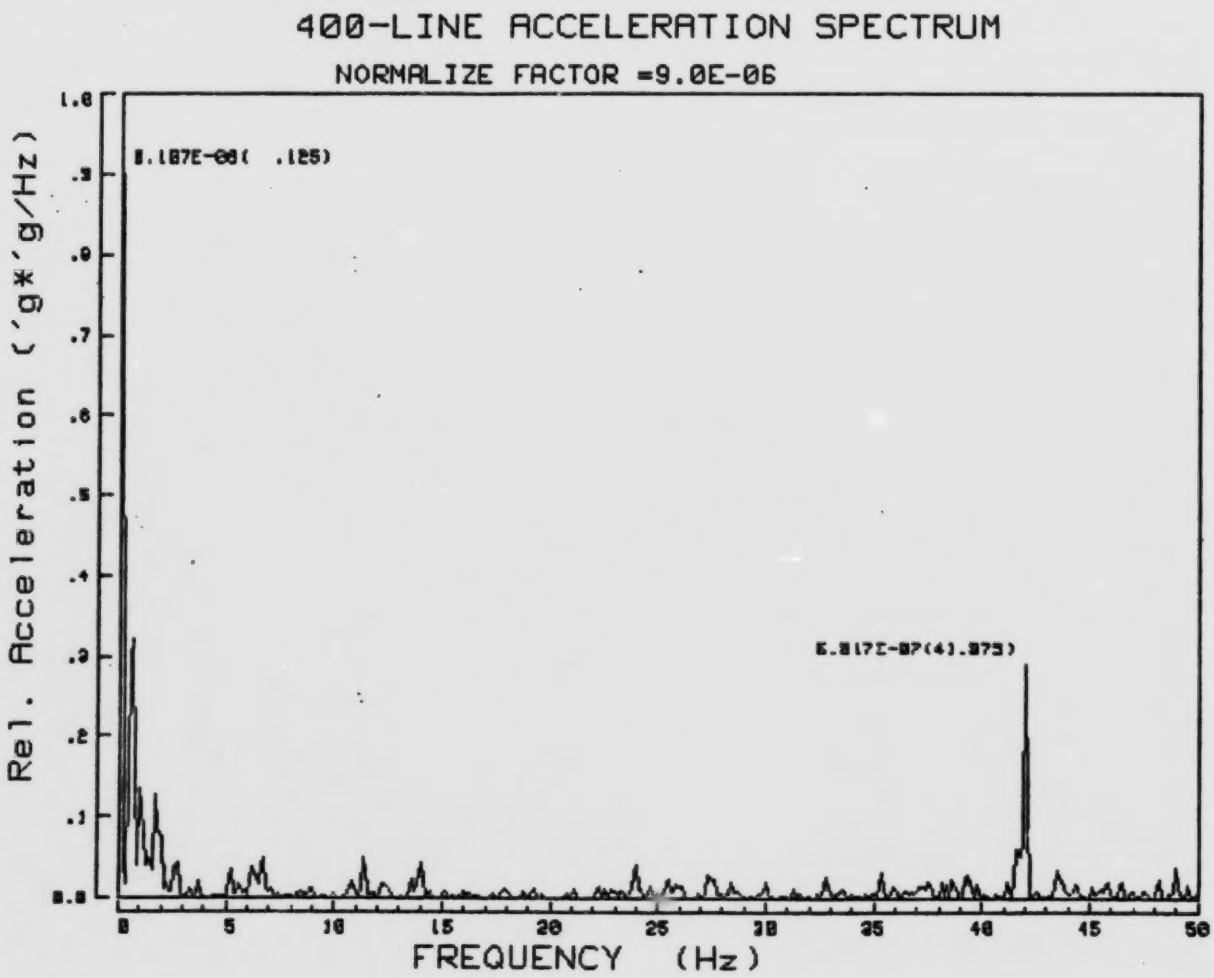


FIGURE 7.1h

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA
Sensor : ACC. 5X
Frequency: 50
File Name: F85X0
Test Time:FEB 8 1981 (02:23)
Calibration: 1.1940 (g'/v)
Sen.Range: .100(v)

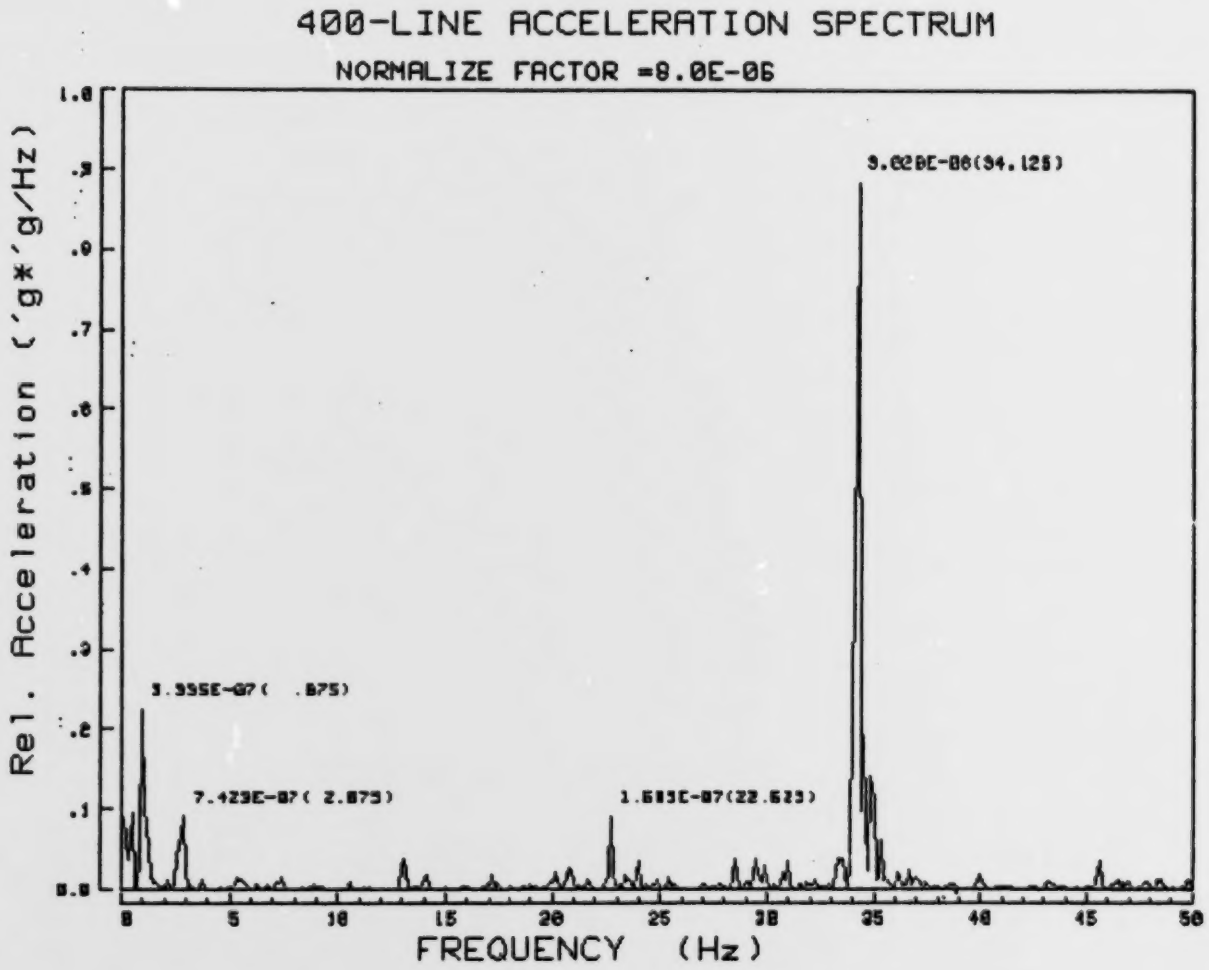


FIGURE 7.1i

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA
Test Time:FEB 8 1981 (02:23)
Sensor : ACC. 5Y
Calibration: 1.2270 (g'/v)
Frequency: 50
Sen.Range: .100(v)
File Name: F85Y0

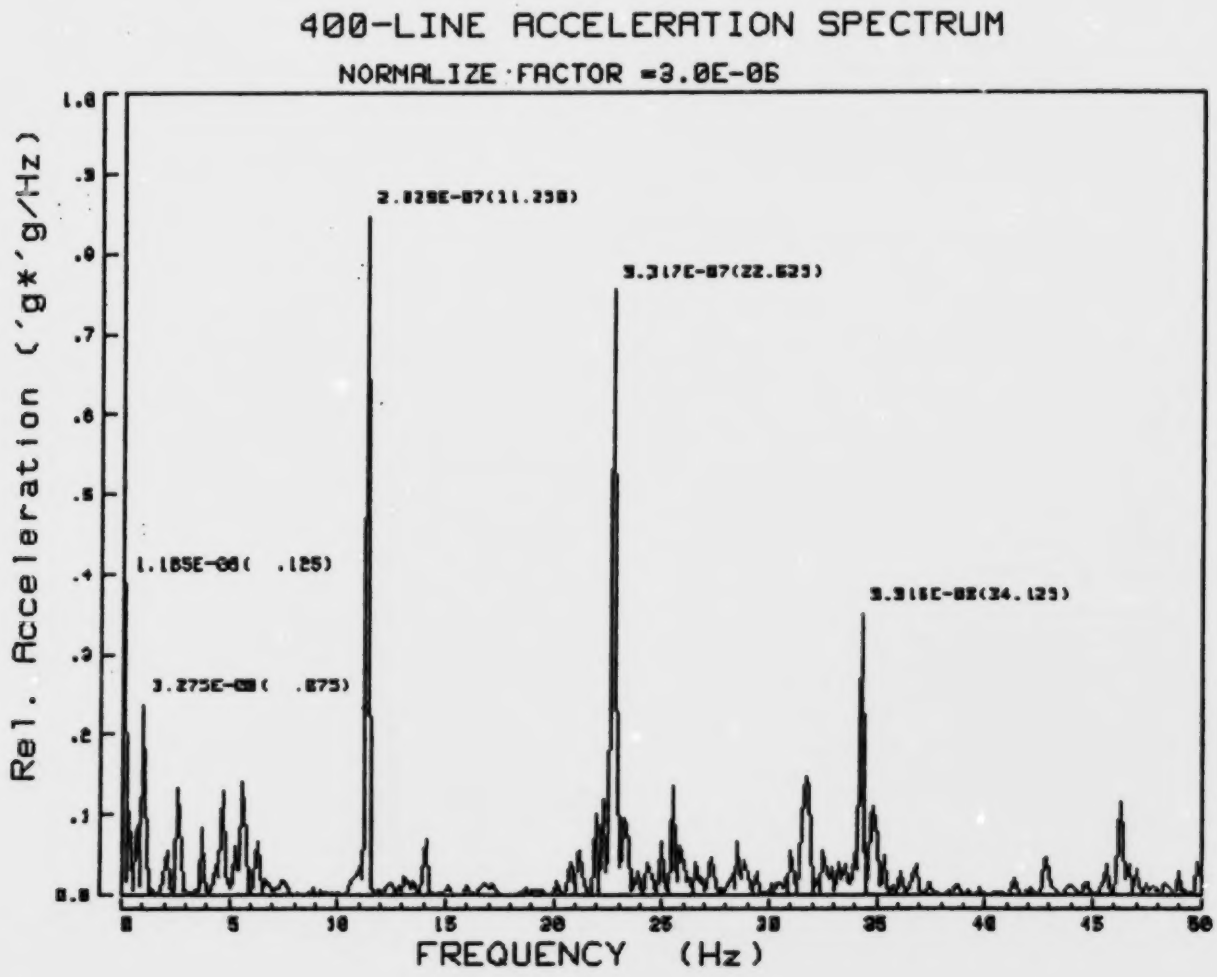


FIGURE 7.1j

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5′ L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA
Sensor : ACC. SZ
Frequency: 50
File Name: F85Z0
Test Time:FEB 8 1981 (02:23)
Calibration: 1.2422 (g′/v)
Sen.Range: .200(v)

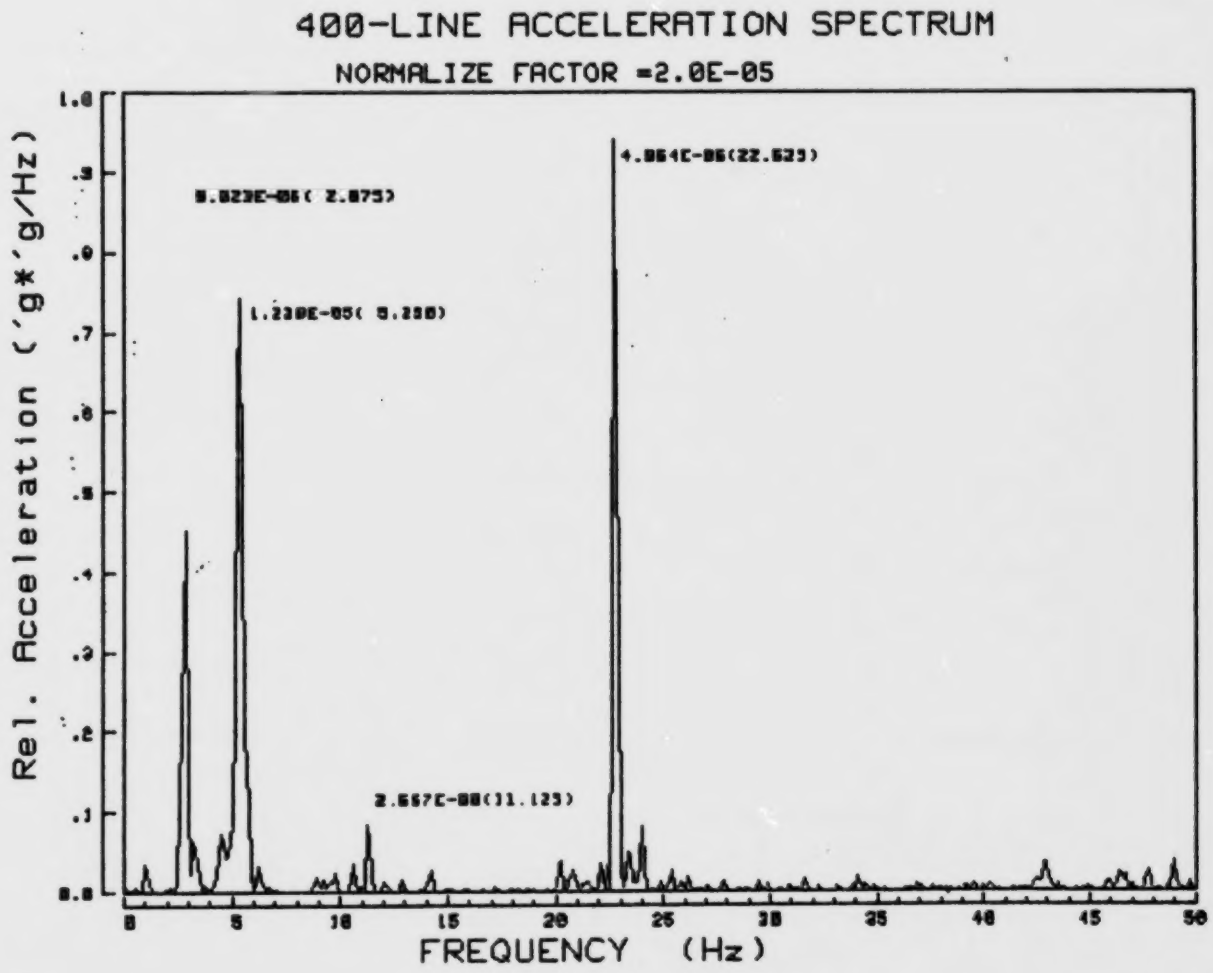


FIGURE 7.1 k

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5′ L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA
Sensor : ACC. 6X
Frequency: 50
File Name: F86X0
Test Time:FEB 8 1981 (02:23)
Calibration: 1.1985 (g′/v)
Sen.Range: .200(v)

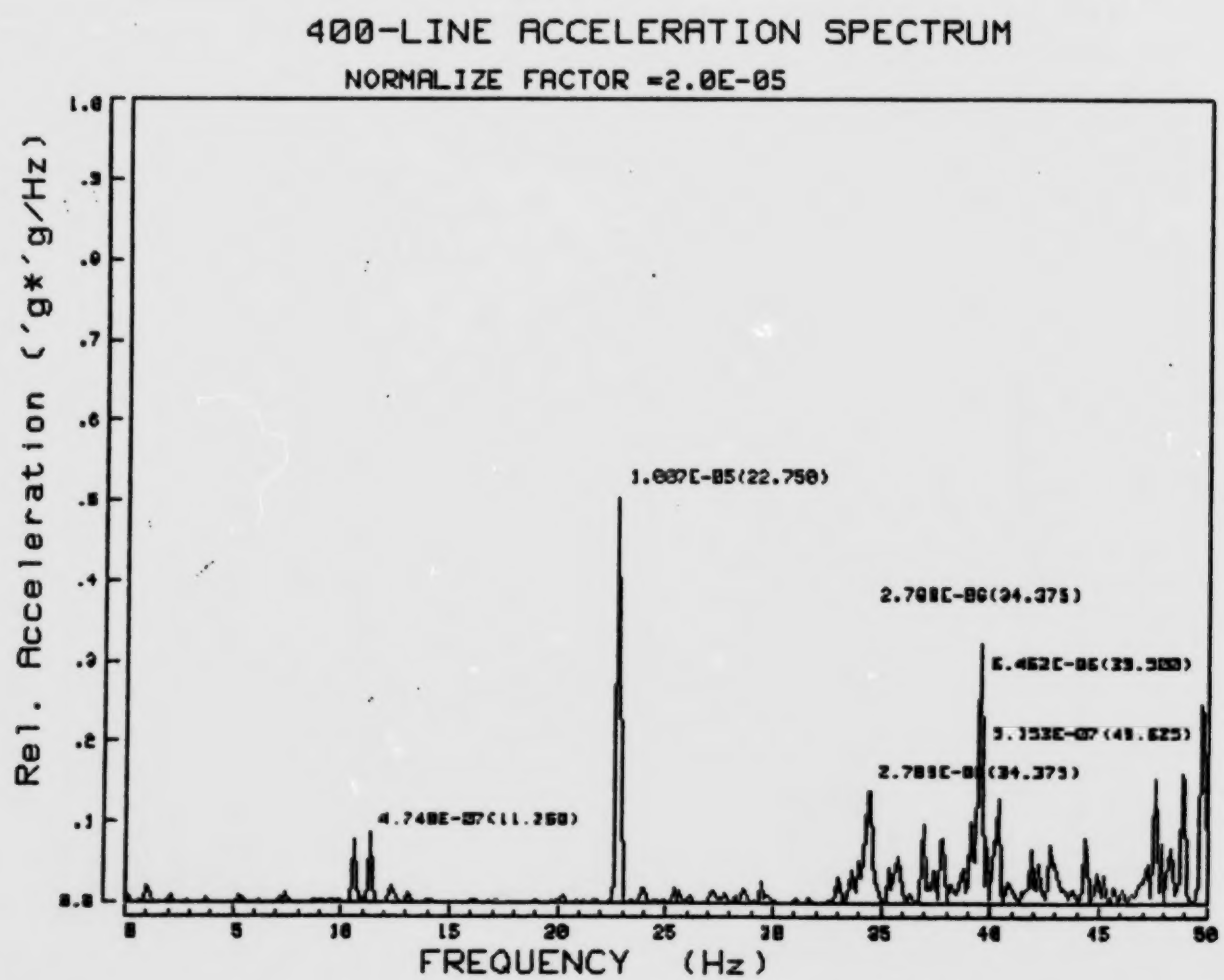


FIGURE 7.1L

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5′ L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA
Sensor : ACC. 6Y
Frequency: 50
File Name: F86Y0
Test Time:FEB 8 1981 (02:23)
Calibration: 1.2422 (g′/v)
Sen.Range: .200(v)

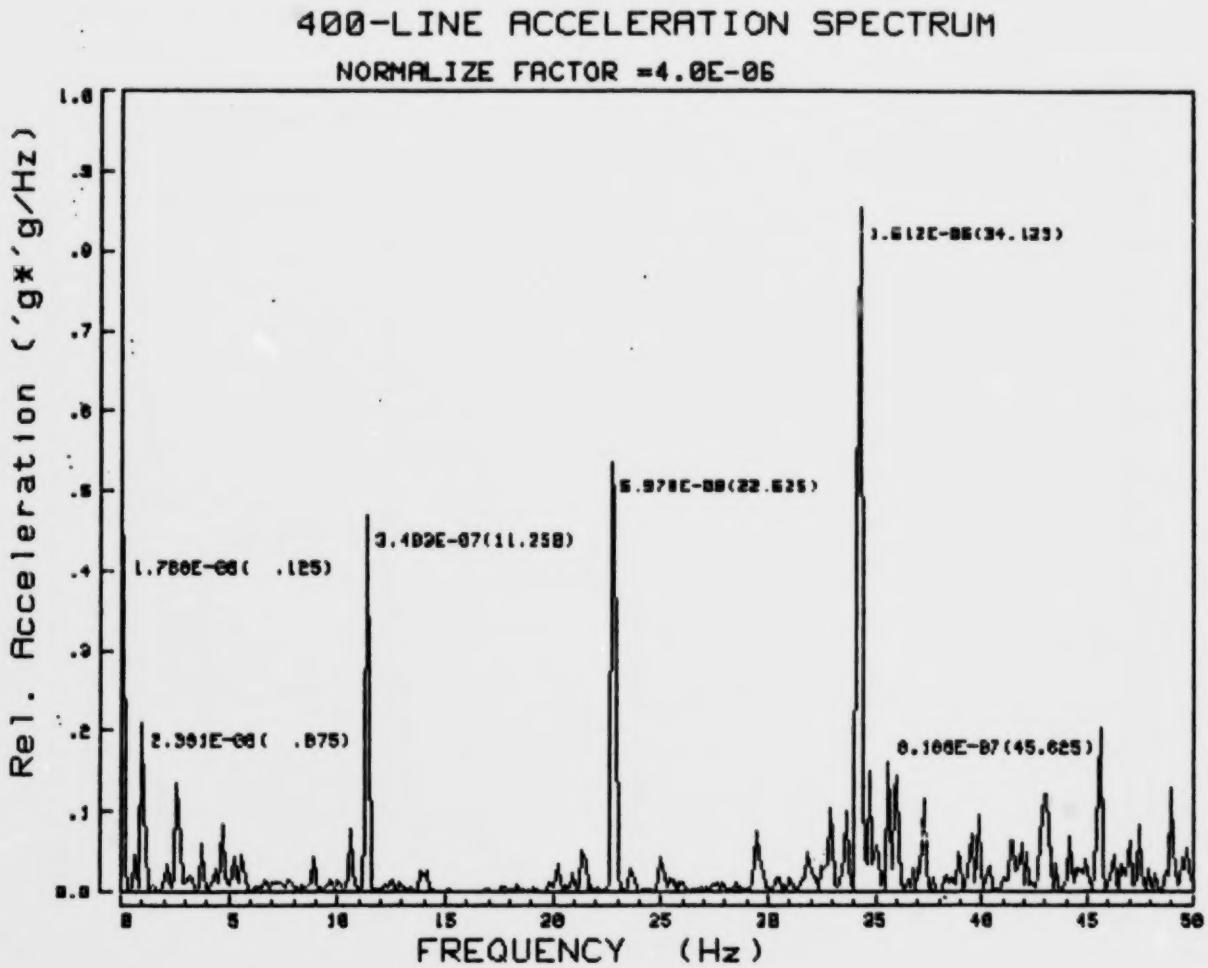


FIGURE 7.1m

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA
Sensor : ACC. 7X
Frequency: 50
File Name: F87X0
Test Time:FEB 8 1981 (02:23)
Calibration: 1.1834 (g'/v)
Sen.Range: .500(v)

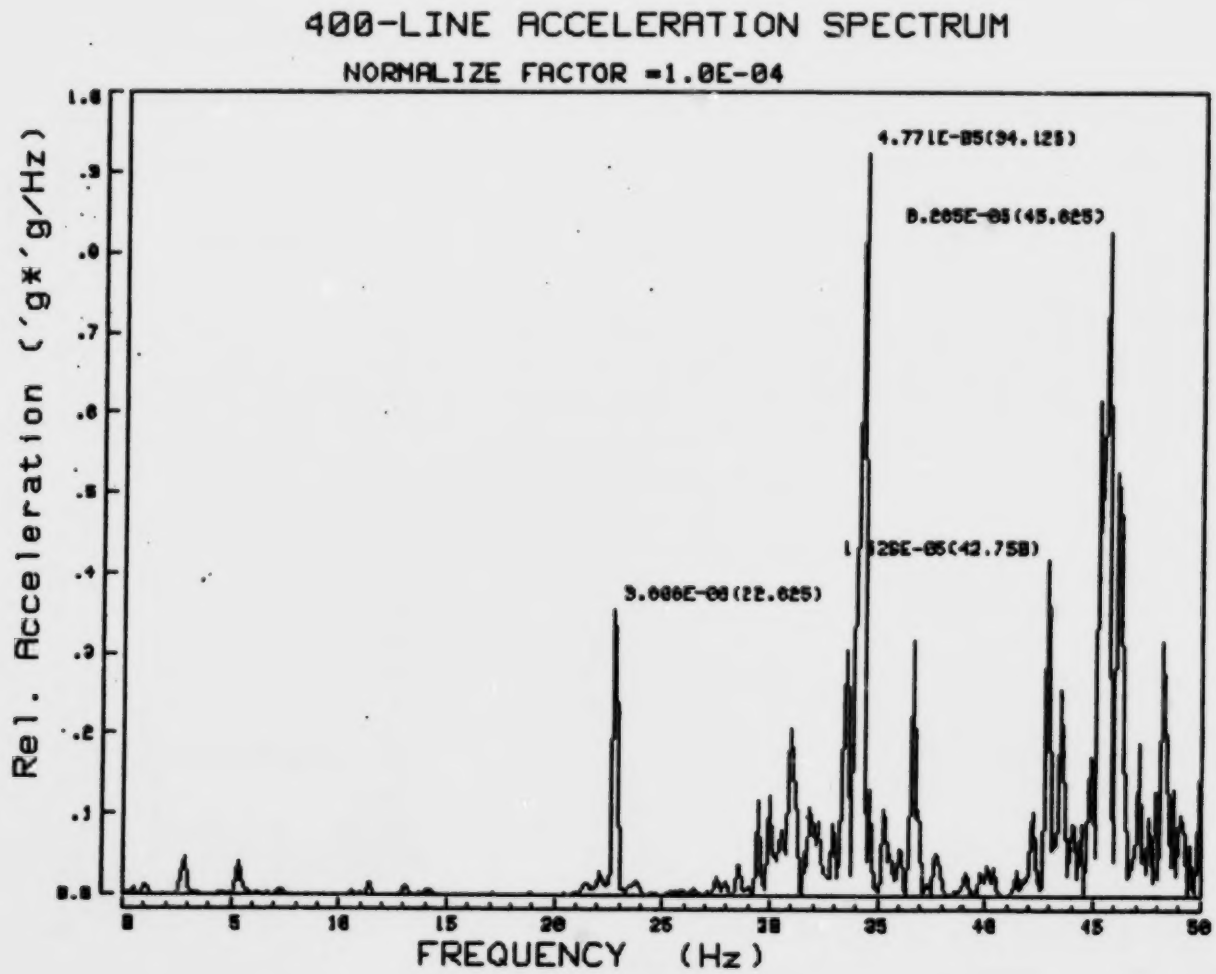


FIGURE 7.1n

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA
Test Time:FEB 8 1981 (02:23)
Sensor : ACC. 7Y
Calibration: 1.2270 (g'/v)
Frequency: 50
Sen.Range: .500(v)
File Name: F87Y0

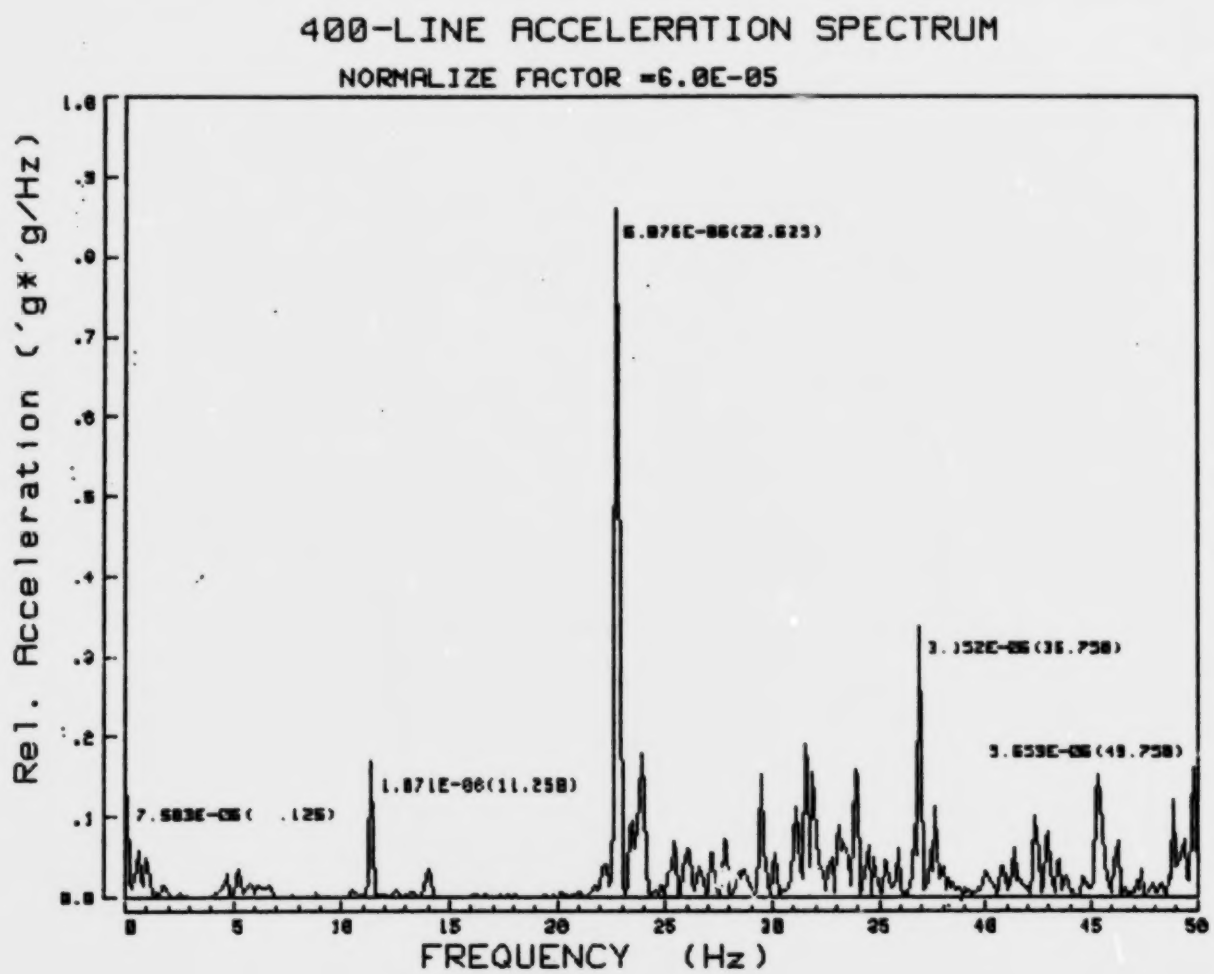


FIGURE 7.1o

ARCTEC CANADA LIMITED

400-LINE SPECTRUM DATA INTERPRETATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5′ L.I. RAMMING HEAD-ON
Vessel : USCGC POLAR SEA
Test Time:FEB 8 1981 (02:23)
Sensor : ACC. 7Z
Calibration: 1.2345 (g′/v)
Frequency: 50
Sen.Range: .500(v)
File Name: F87Z0

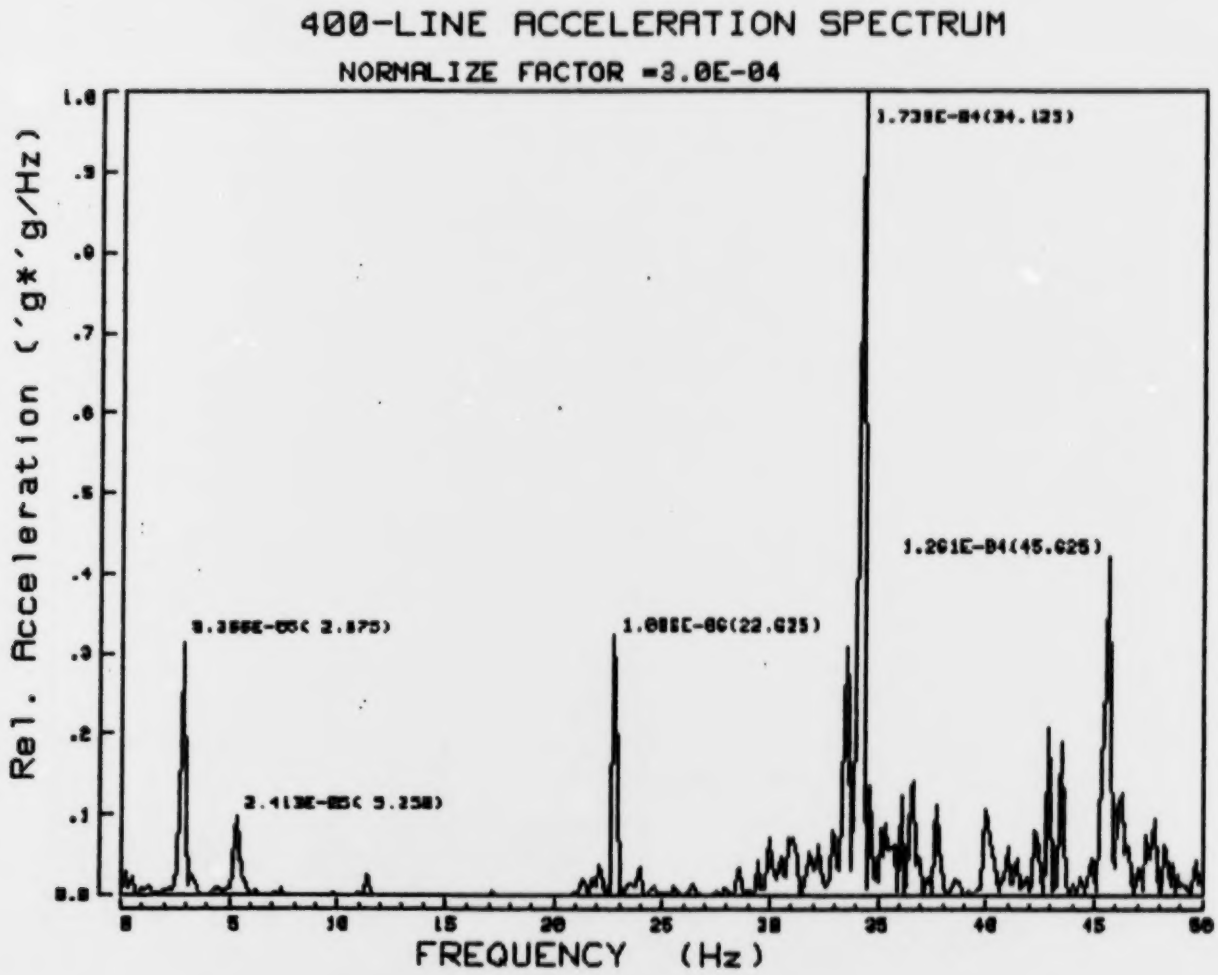


FIGURE 7.2a

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING
Vessel : USCGC POLAR SEA — Test Time:FEB 8 1981 (02:23)
Sensor : ACC 1Y — Cal.Factor: 1.194('g/v)
FreqRange: 50 (Hz) — Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending — File Name: F81Y8
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 28
* Cut-off frequency for force calculation is 15 (Hz)

Mean Square= 1.207214E+03(L.ton*L.ton)
Root Mean Square= 3.474499E+01(L.ton)

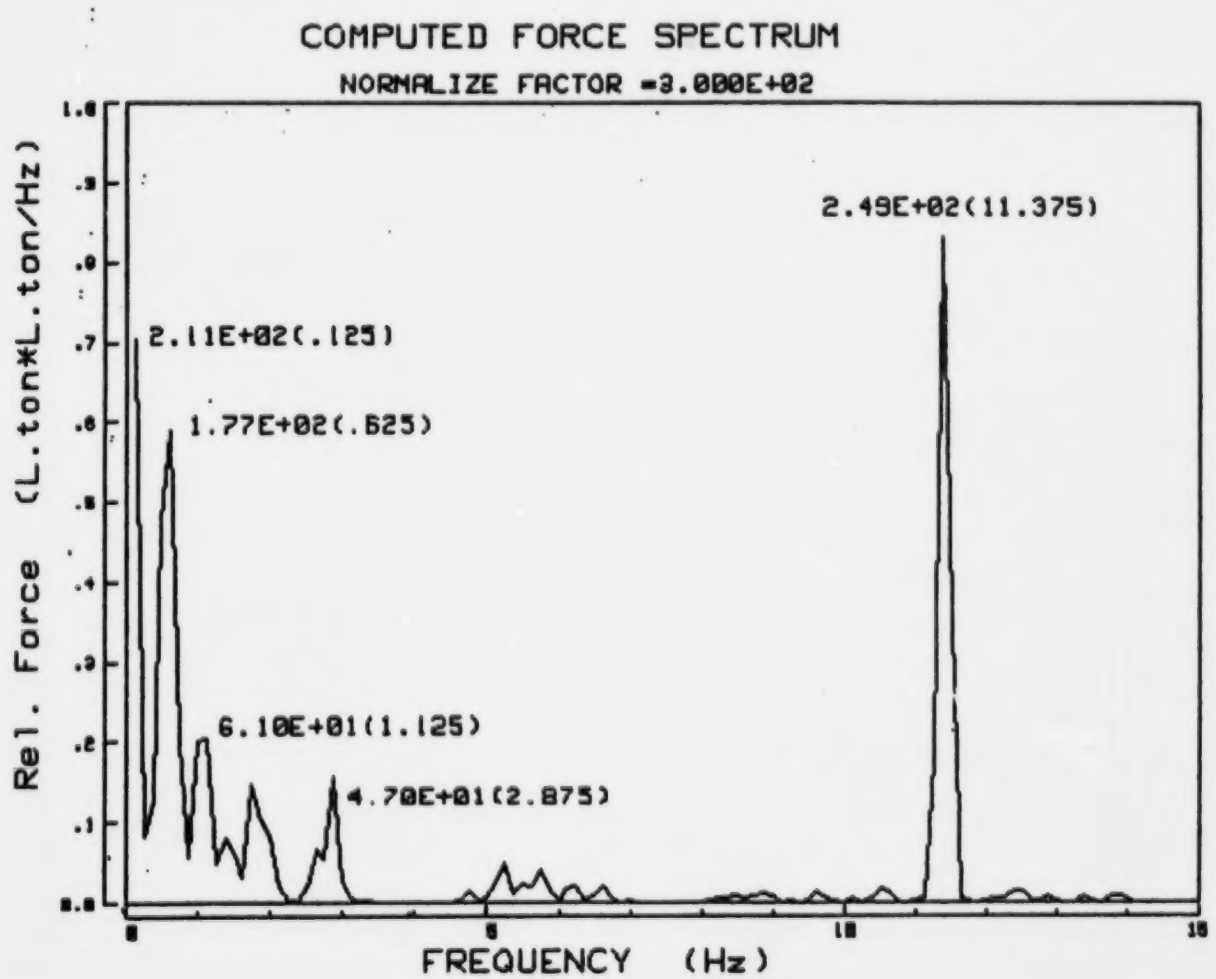


FIGURE 7.2b

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (02:23)
Sensor  : ACC. 2Y                        Cal.Factor: 1.274('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F82Y0
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.094194E+03(L.ton*L.ton)
  Root Mean Square= 3.307860E+01(L.ton)
```

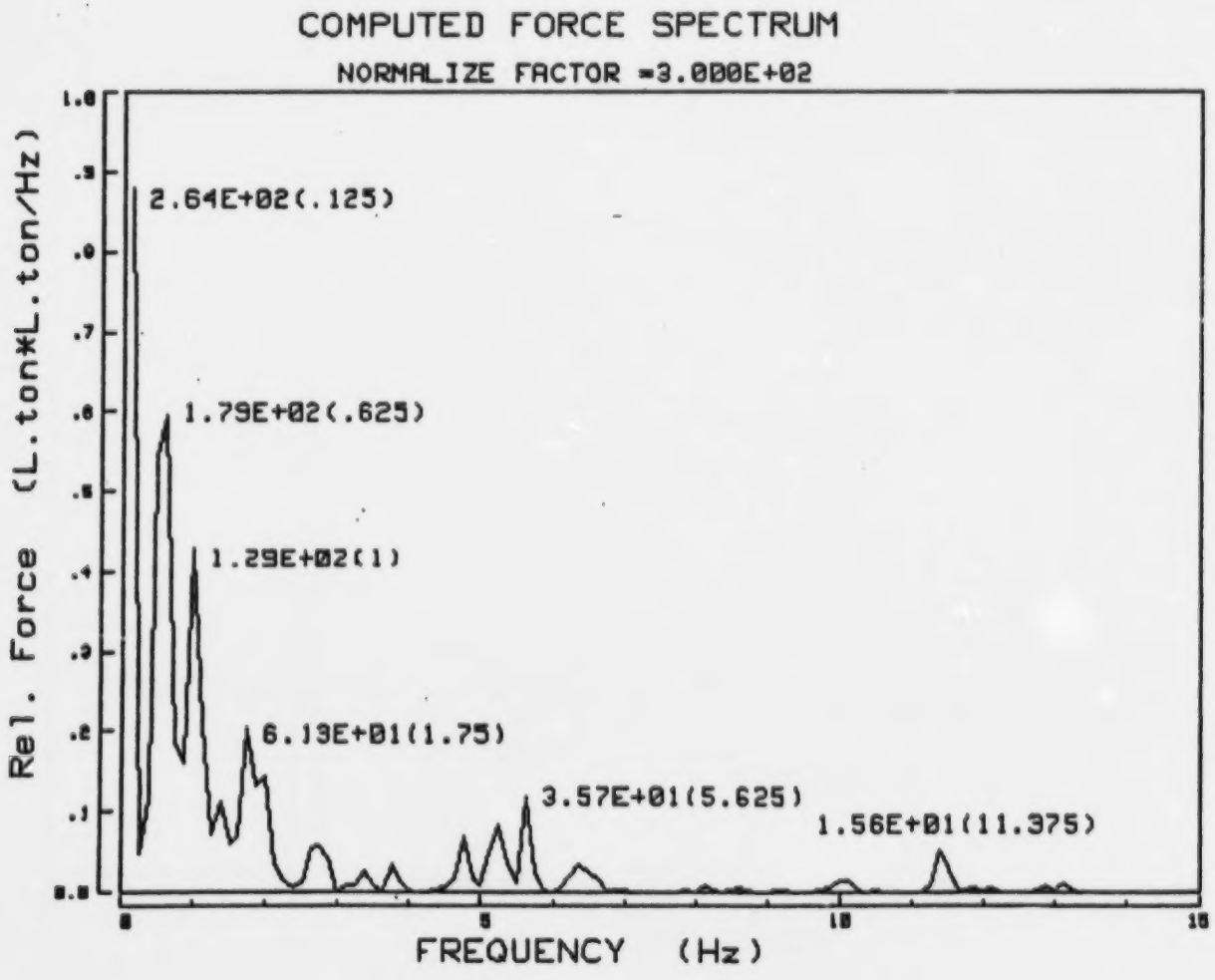


FIGURE 7.2c

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING
Vessel  : USCGC POLAE SEA                Test Time:FEB 8 1981 (02:23)
Sensor  : ACC. 3Y                        Cal.Factor:1.2195('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F83Y0
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 16.14
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean       Square= 1.342215E+03(L.ton*L.ton)
  Root Mean Square= 3.663626E+01(L.ton)
```

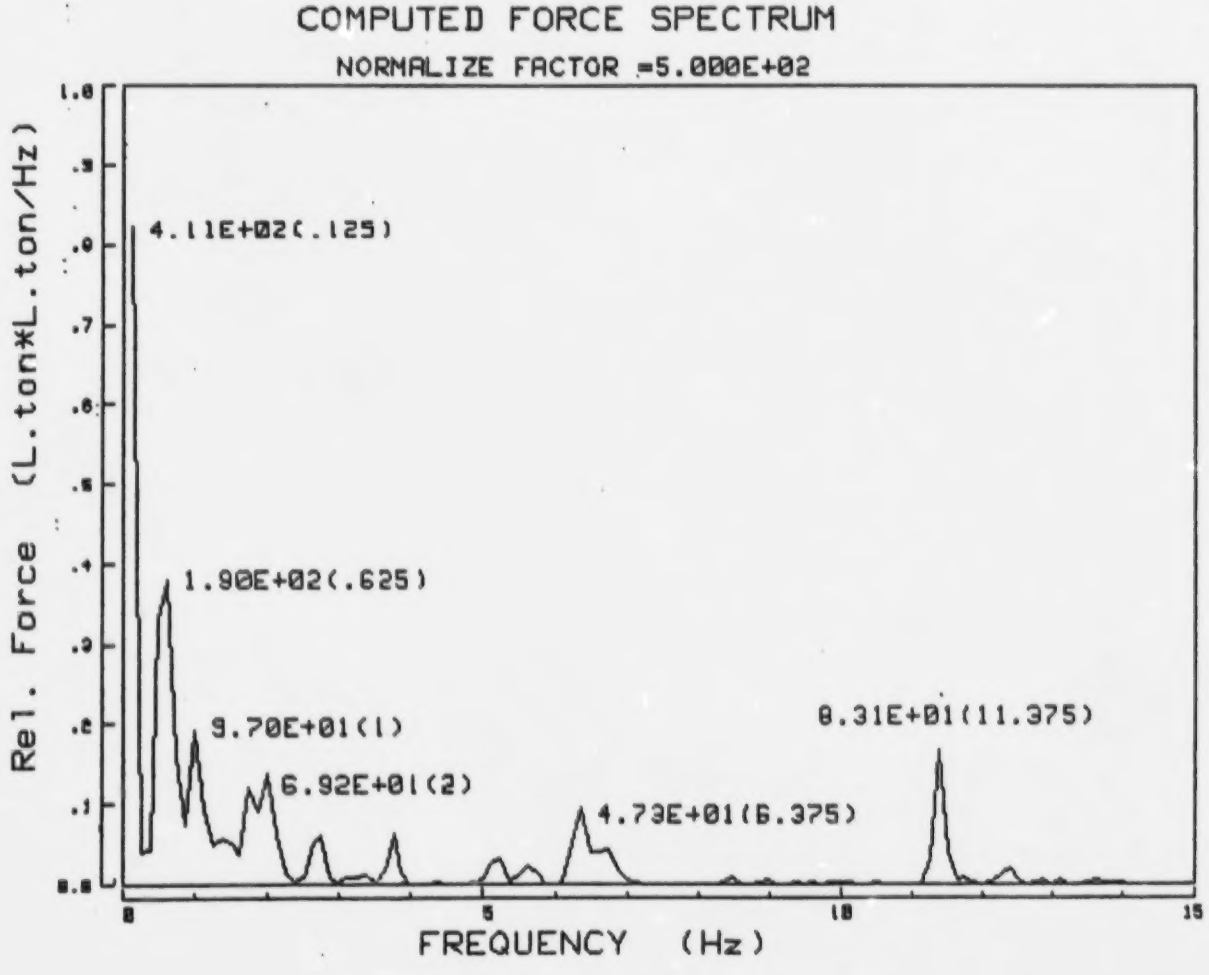


FIGURE 7.2d

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMIMG
Vessel  : USCGC POLAE SEA                Test Time:FEB 8 1981 (02:23)
Sensor  : ACC. 5Y                        Cal.Factor:1.2270('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F85Y0
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 7.938996E+02(L.ton*L.ton)
  Root Mean Square= 2.817622E+01(L.ton)
```

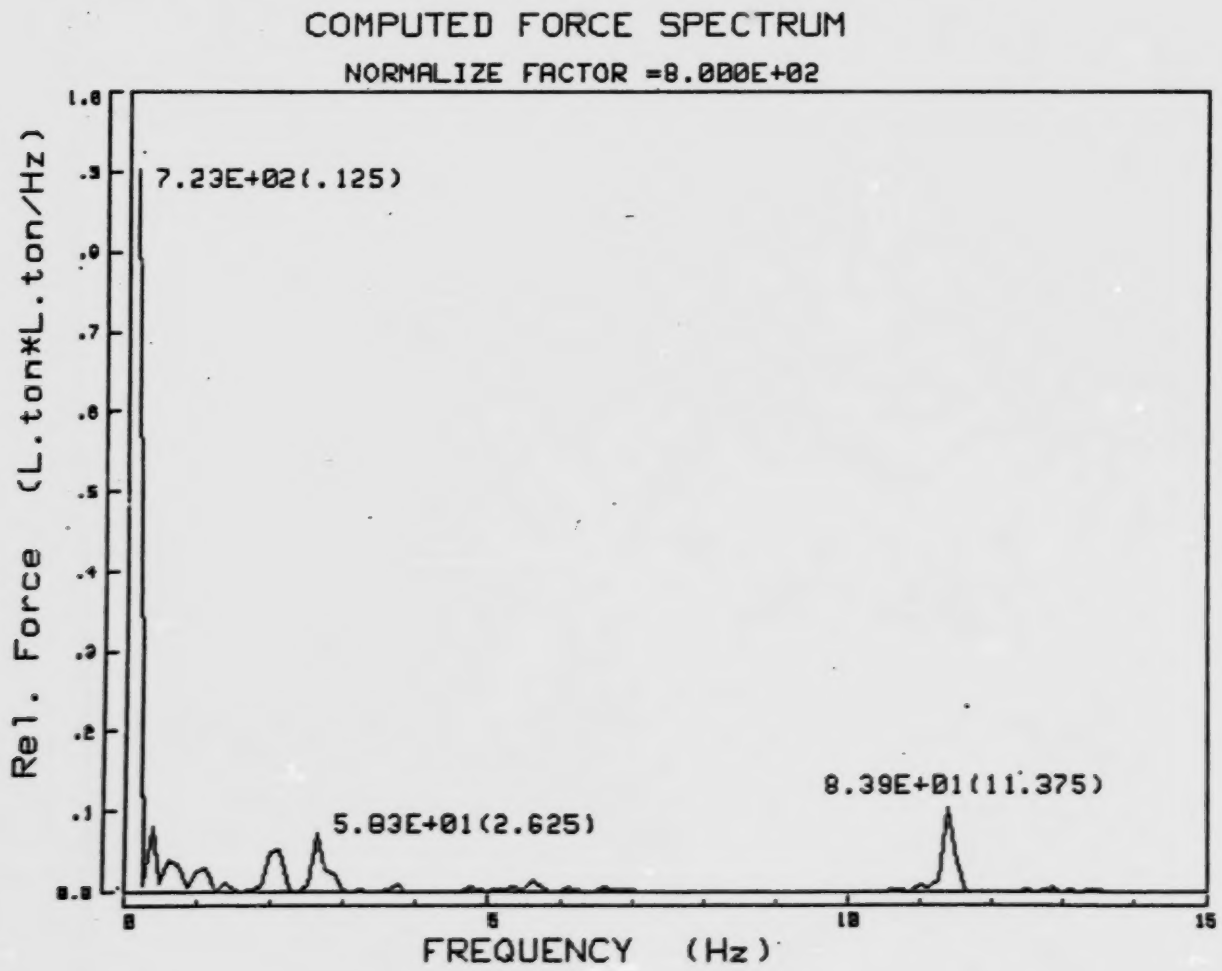


FIGURE 7.2e

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING
Vessel  : USCGC POLAE SEA                Test Time:FEB 8 1981 (02:23)
Sensor  : ACC. 6Y                        Cal.Factor:1.2422('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F86Y0
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.376696E+03(L.ton*L.ton)
  Root Mean Square= 3.710386E+01(L.ton)
```

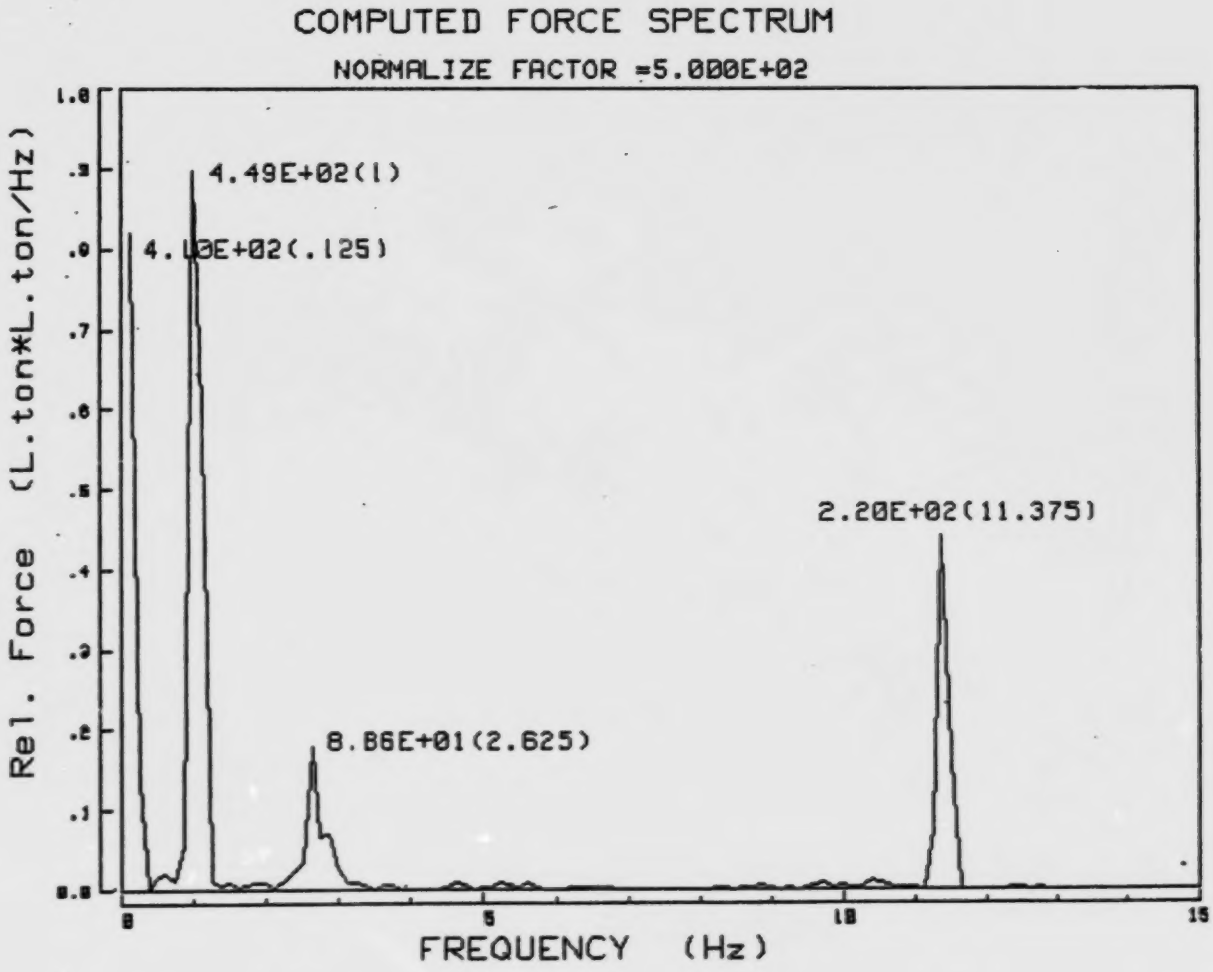


FIGURE 7.2f

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING
Vessel  : USCGC POLAE SEA                Test Time:FEB 8 1981 (02:23)
Sensor  : ACC. 7Y                        Cal.Factor:1.2270('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F87Y0
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.408140E+03(L.ton*L.ton)
  Root Mean Square= 3.752520E+01(L.ton)
```

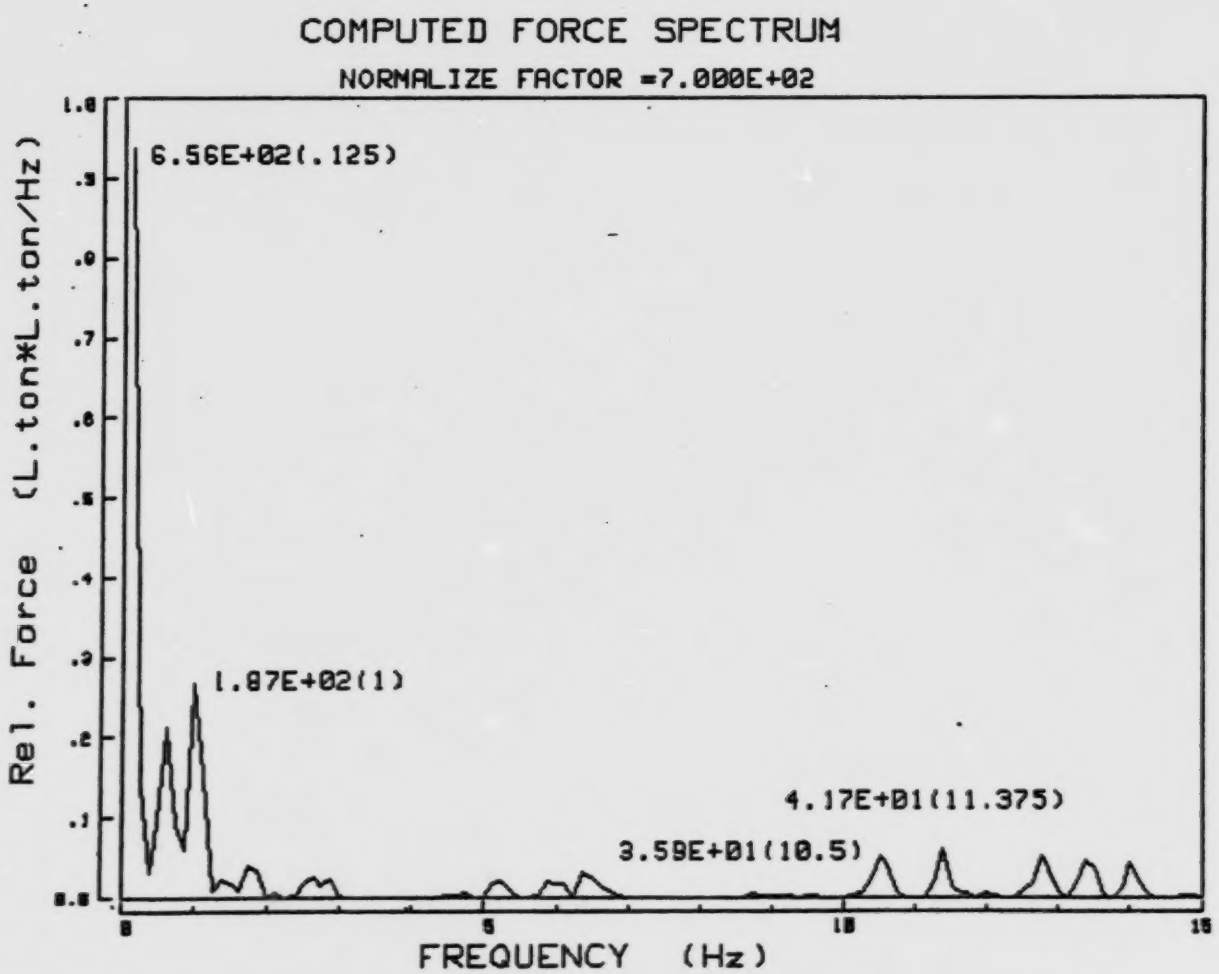


FIGURE 7.2g

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING
Vessel  : USCGC POLAE SEA                Test Time:FEB 8 1981 (02:23)
Sensor  : ACC 1Z                         Cal.Factor: 1.250('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F81Z0
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 20
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 2.278805E+03(L.ton*L.ton)
  Root Mean Square= 4.773683E+01(L.ton)
```

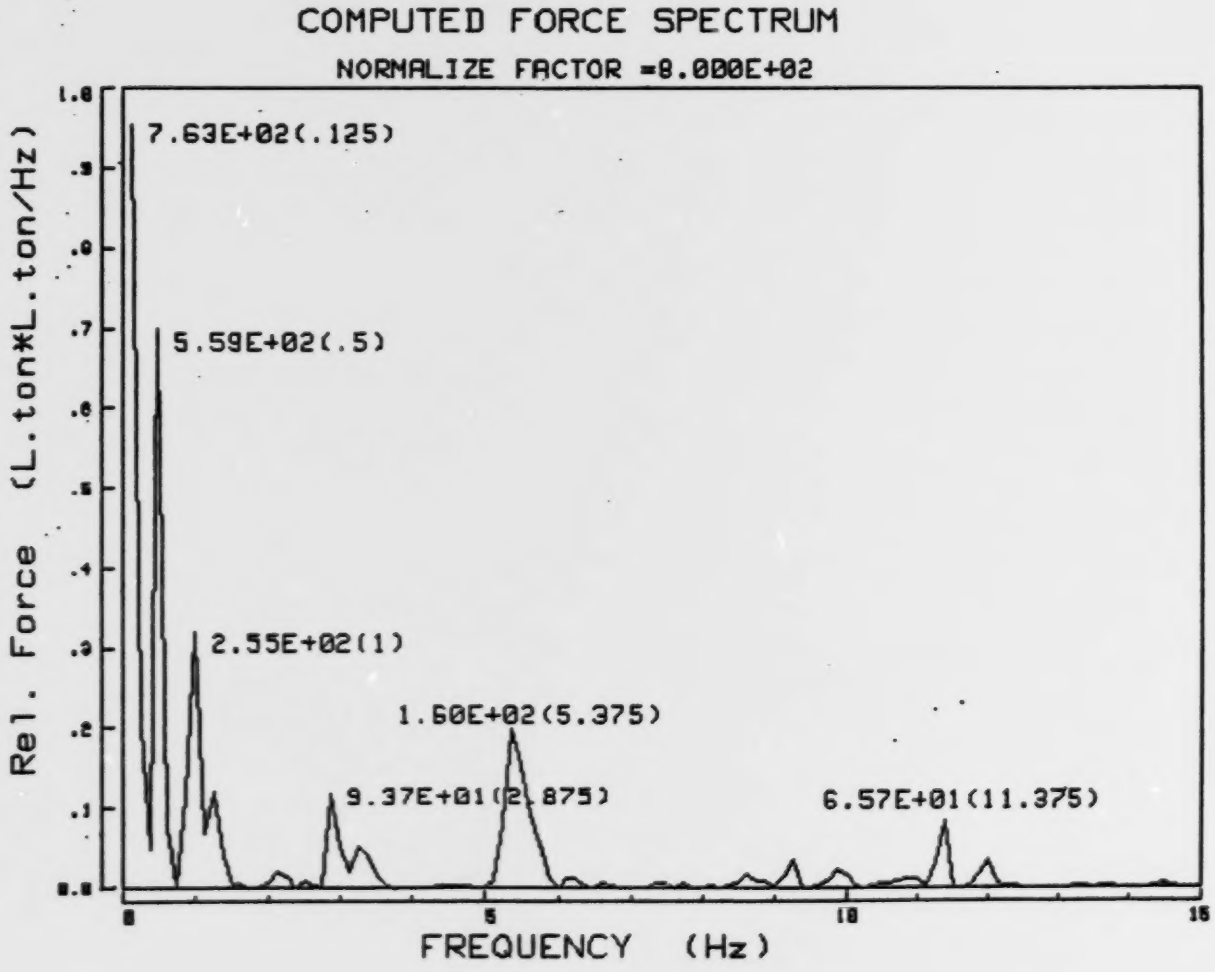


FIGURE 7.2h

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING
Vessel  : USCGC POLAE SEA                Test Time:FEB 8 1981 (02:23)
Sensor  : ACC. 2Z                        Cal.Factor: 1.250('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F82Z0
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 3.110502E+03(L.ton*L.ton)
  Root Mean Square= 5.577187E+01(L.ton)
```

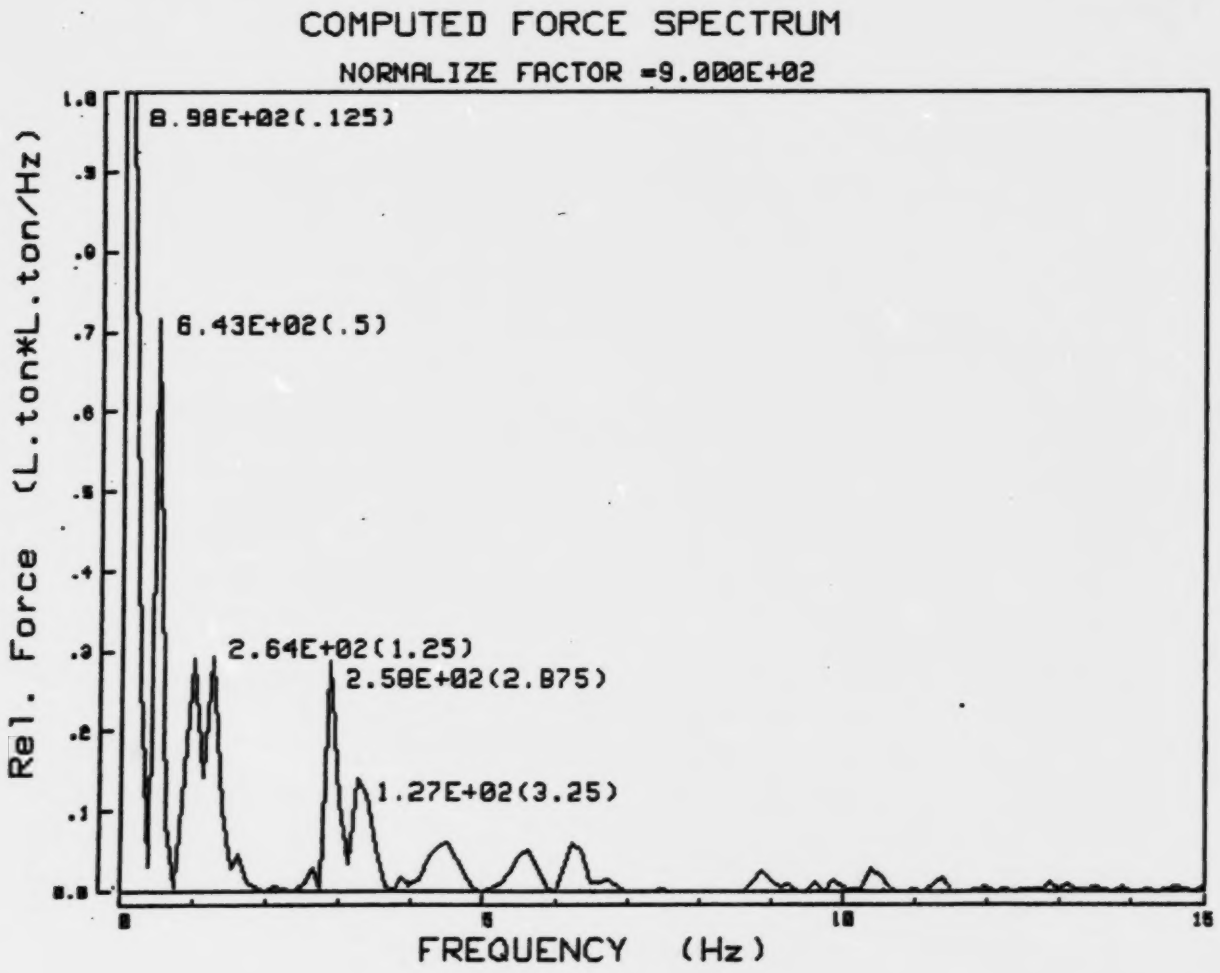


FIGURE 7.21

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S TEST - 3.5' L.I. RAMMING
Vessel  : USCGC POLAE SEA                Test Time:FEB 8 1981 (02:23)
Sensor  : ACC. SZ                        Cal.Factor: 1.242('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F85Z0
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 2.453290E+03(L.ton*L.ton)
  Root Mean Square= 4.953070E+01(L.ton)
```

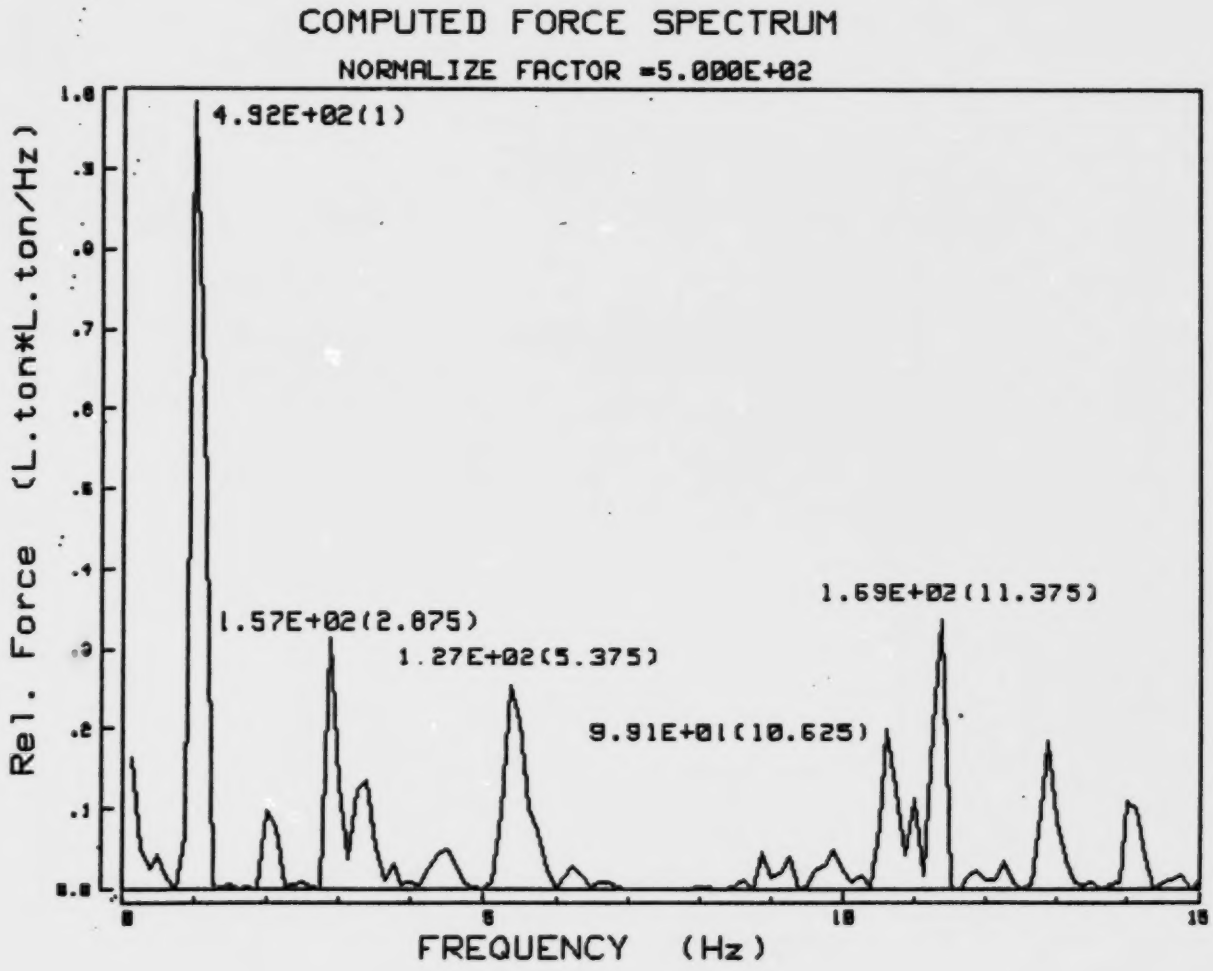


FIGURE 7.2j

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 3.5′ L.I. RAMMING
Vessel : USCGC POLAE SEA Test Time:FEB 8 1981 (02:23)
Sensor : ACC. 7Z Cal.Factor: 1.235(′g/v)
FreqRange: 50 (Hz) Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending File Name: F87Z0
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)

Mean Square= 1.706893E+03(L.ton*L.ton)
Root Mean Square= 4.131457E+01(L.ton)

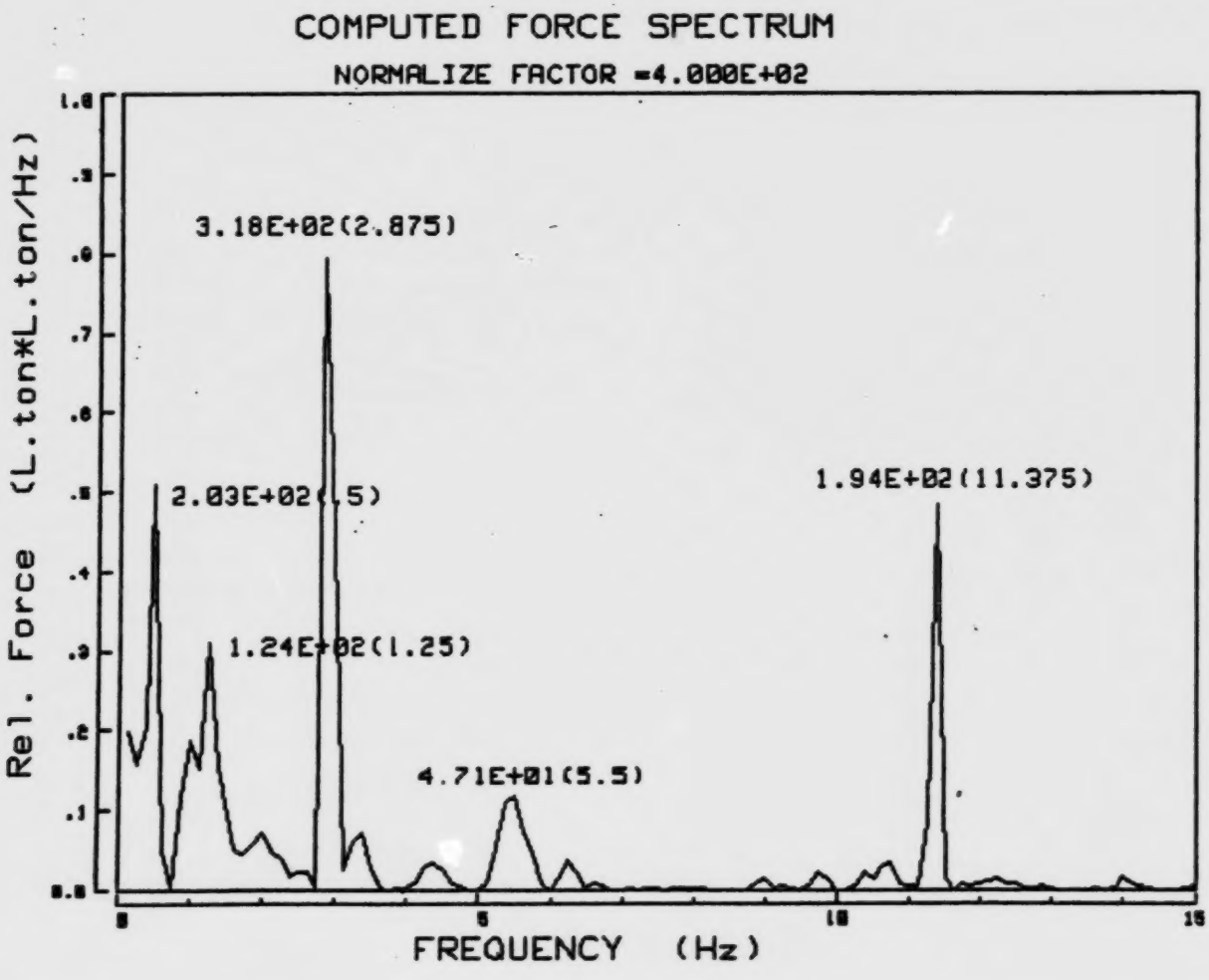


FIGURE 7.3a

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - FULL SCALE TEST - RAMMING MODE
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (02:30)
Sensor  : BOW SWAY                       Cal.Factor: 1.194('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F81Y1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 20
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 9.407223E+04(L.ton*L.ton)
  Root Mean Square= 3.067120E+02(L.ton)
```

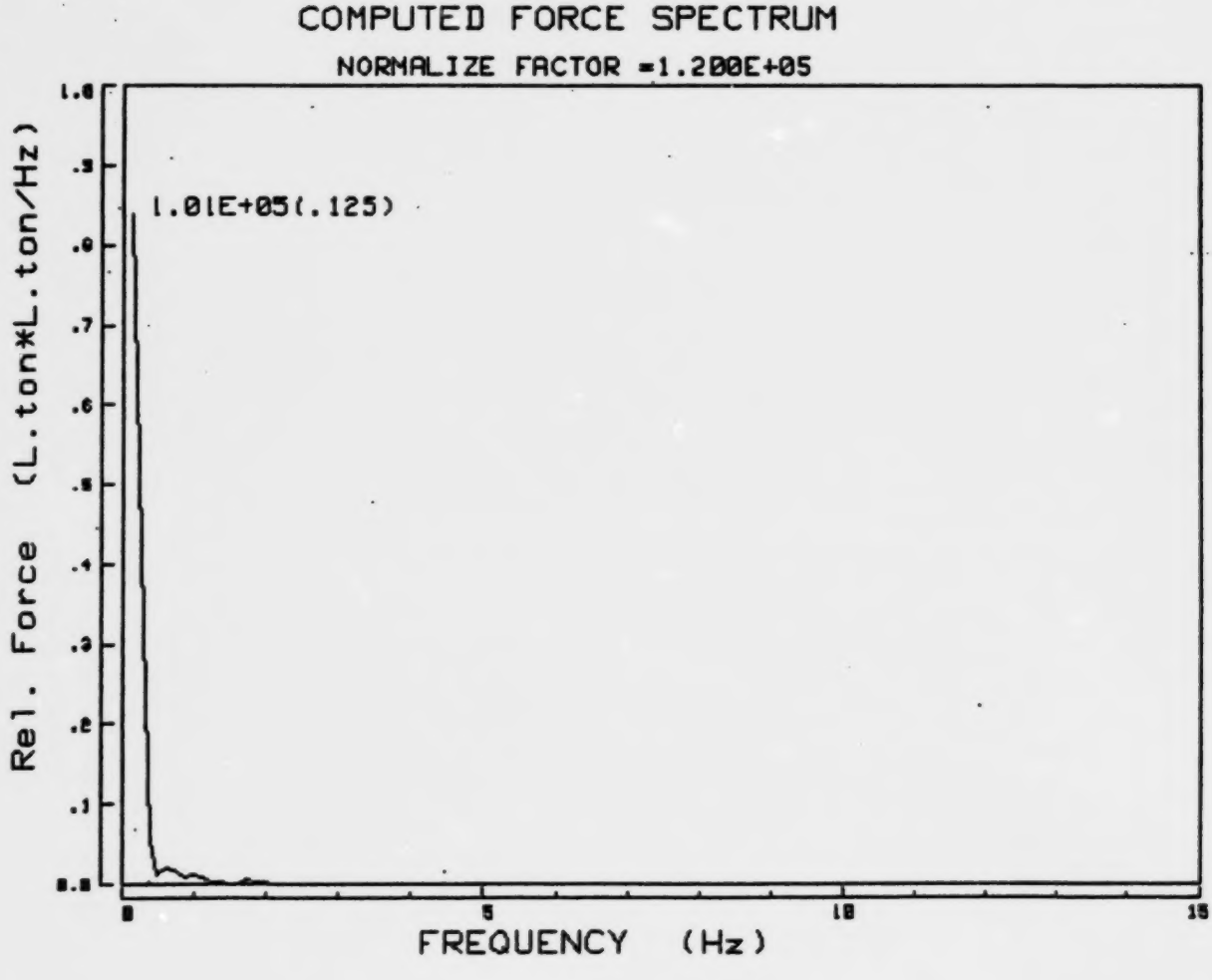


FIGURE 7.3b

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - FULL SCALE TEST - RAMMING MODE
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (02:30)
Sensor  : ACC. 2Y                        Cal.Factor: 1.274('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F82Y1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.105792E+05(L.ton*L.ton)
  Root Mean Square= 3.325345E+02(L.ton)
```

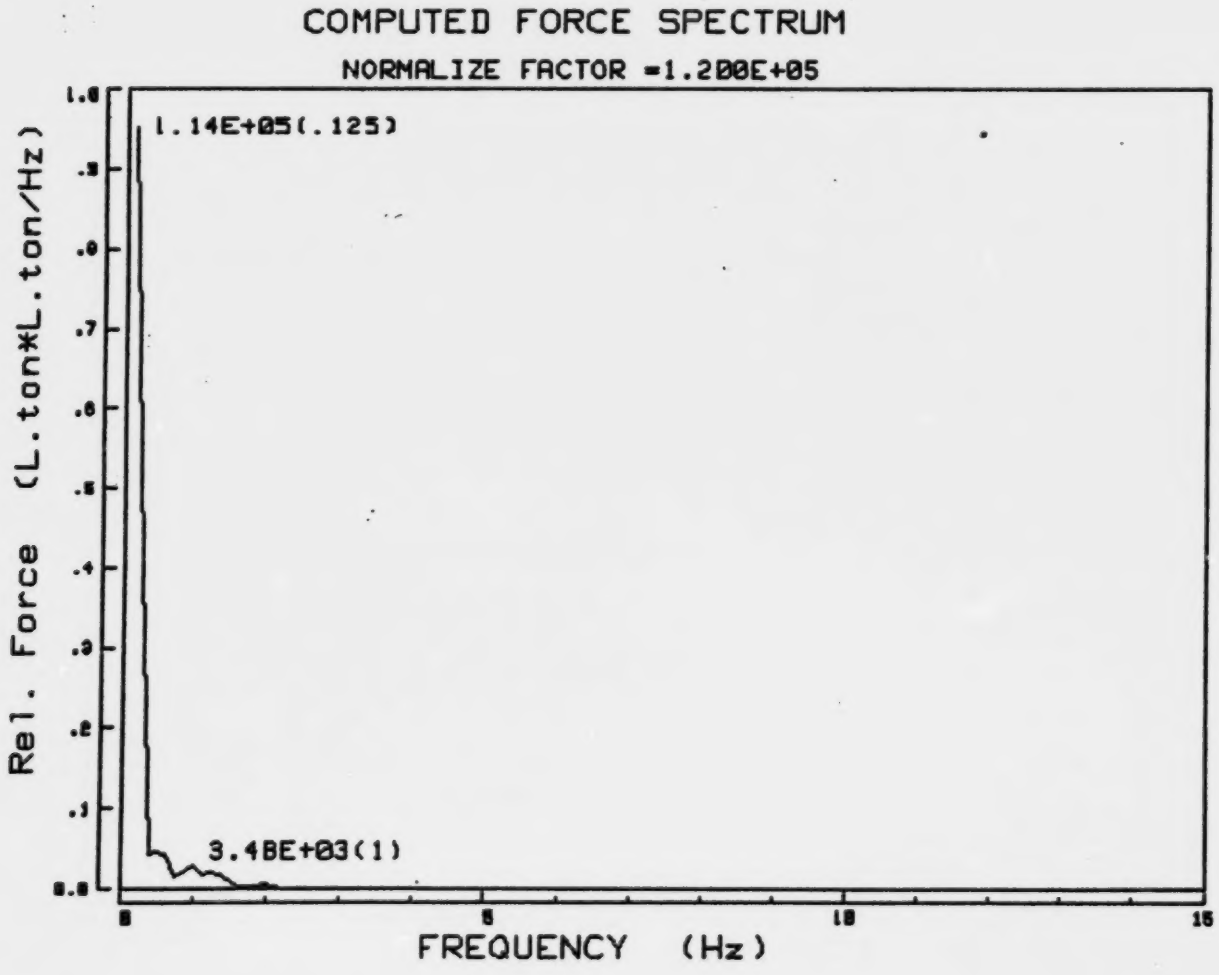


FIGURE 7.3c

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - FULL SCALE TEST - RAMMING MODE
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (02:30)
Sensor  : ACC. 3Y                        Cal.Factor: 1.220('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F83Y1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 16.14
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean       Square= 5.887100E+04(L.ton*L.ton)
  Root Mean Square= 2.426335E+02(L.ton)
```

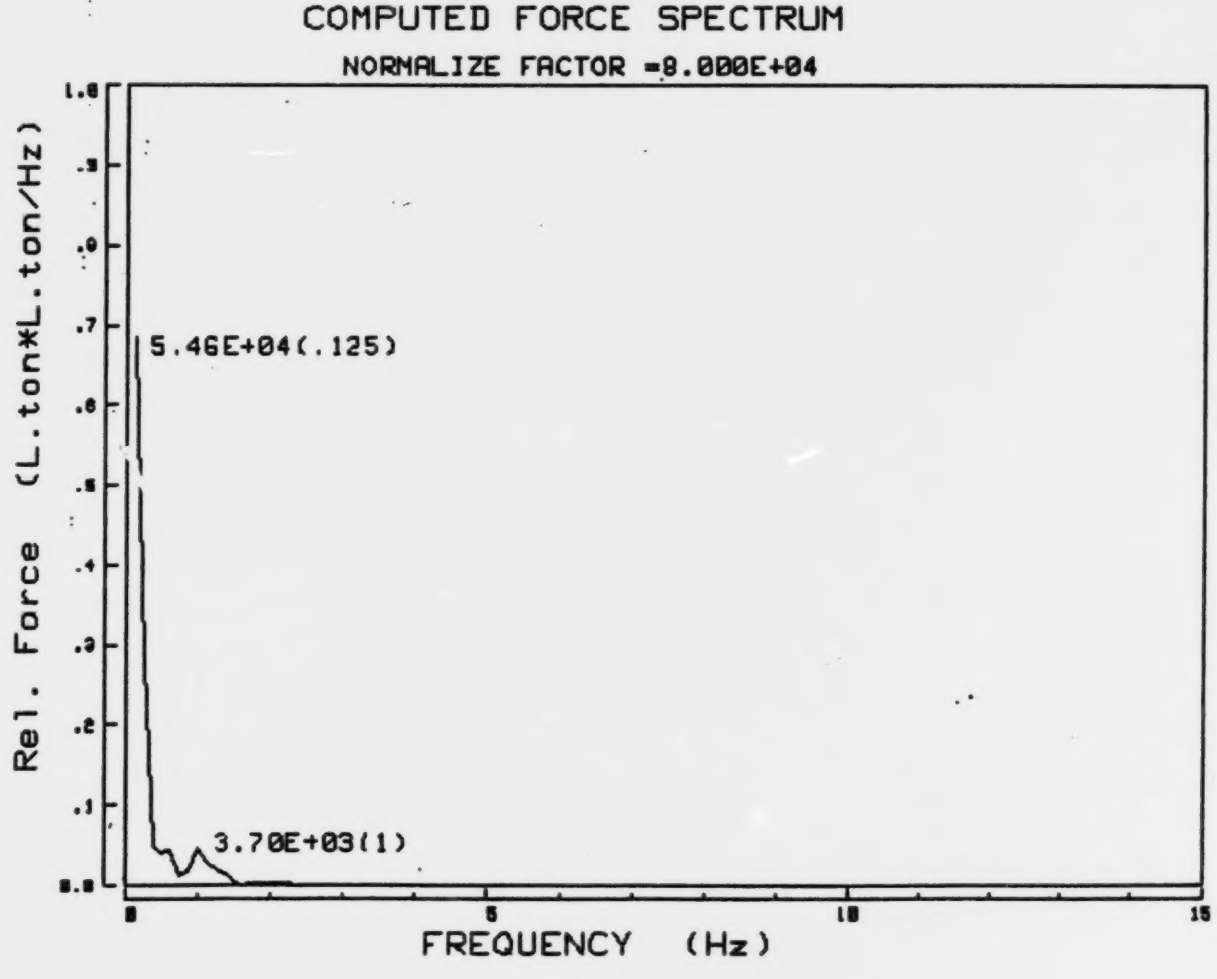


FIGURE 7.3d

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - FULL SCALE TEST - RAMMING MODE
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (02:30)
Sensor  : ACC. 5Y                        Cal.Factor: 1.227('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F85Y1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 6.797371E+04(L.ton*L.ton)
  Root Mean Square= 2.607177E+02(L.ton)
```

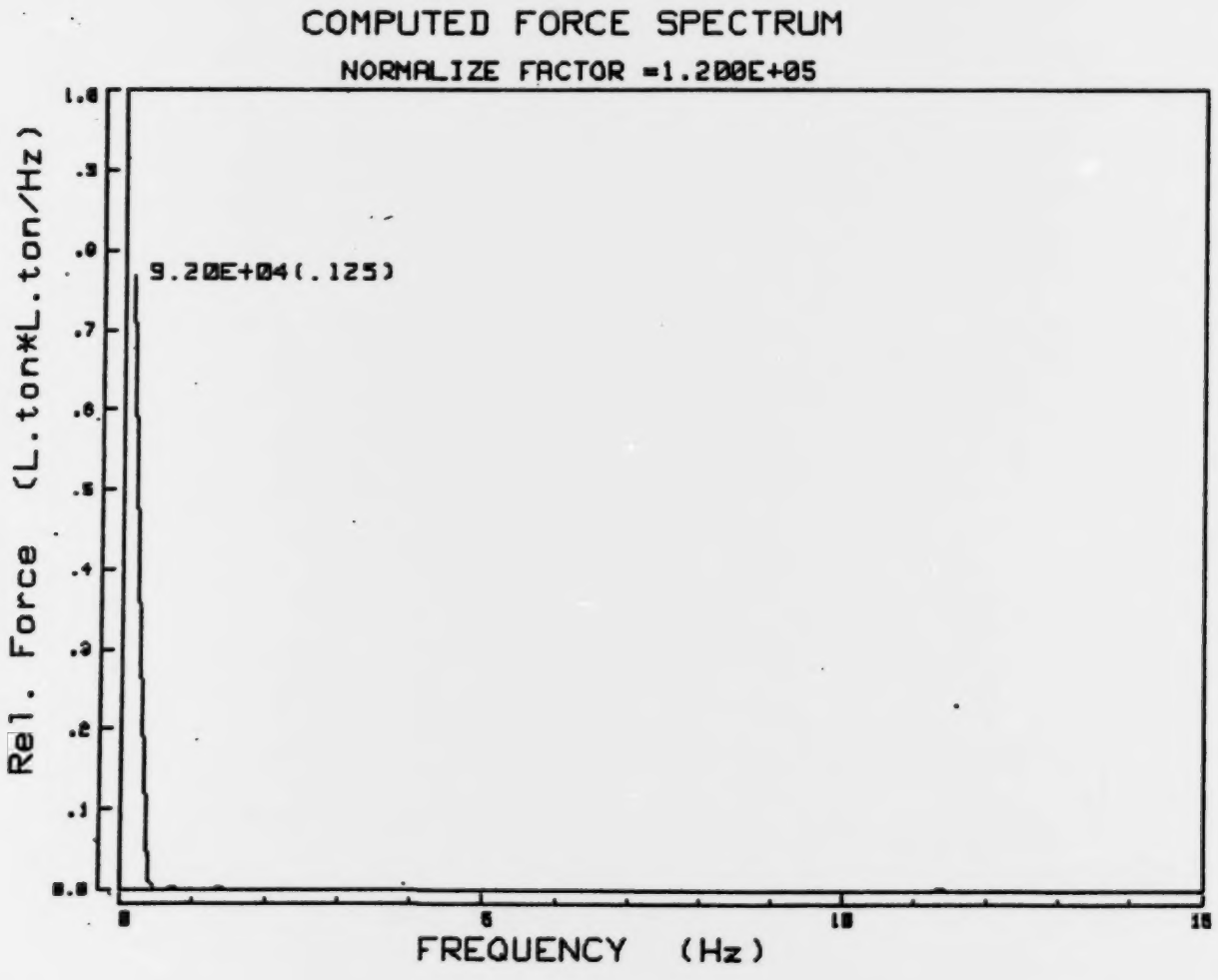


FIGURE 7.3e

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - FULL SCALE TEST - RAMMING MODE
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (02:30)
Sensor  : ACC. 6Y                        Cal.Factor: 1.242('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F86Y1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 2.163207E+04(L.ton*L.ton)
  Root Mean Square= 1.470784E+02(L.ton)
```

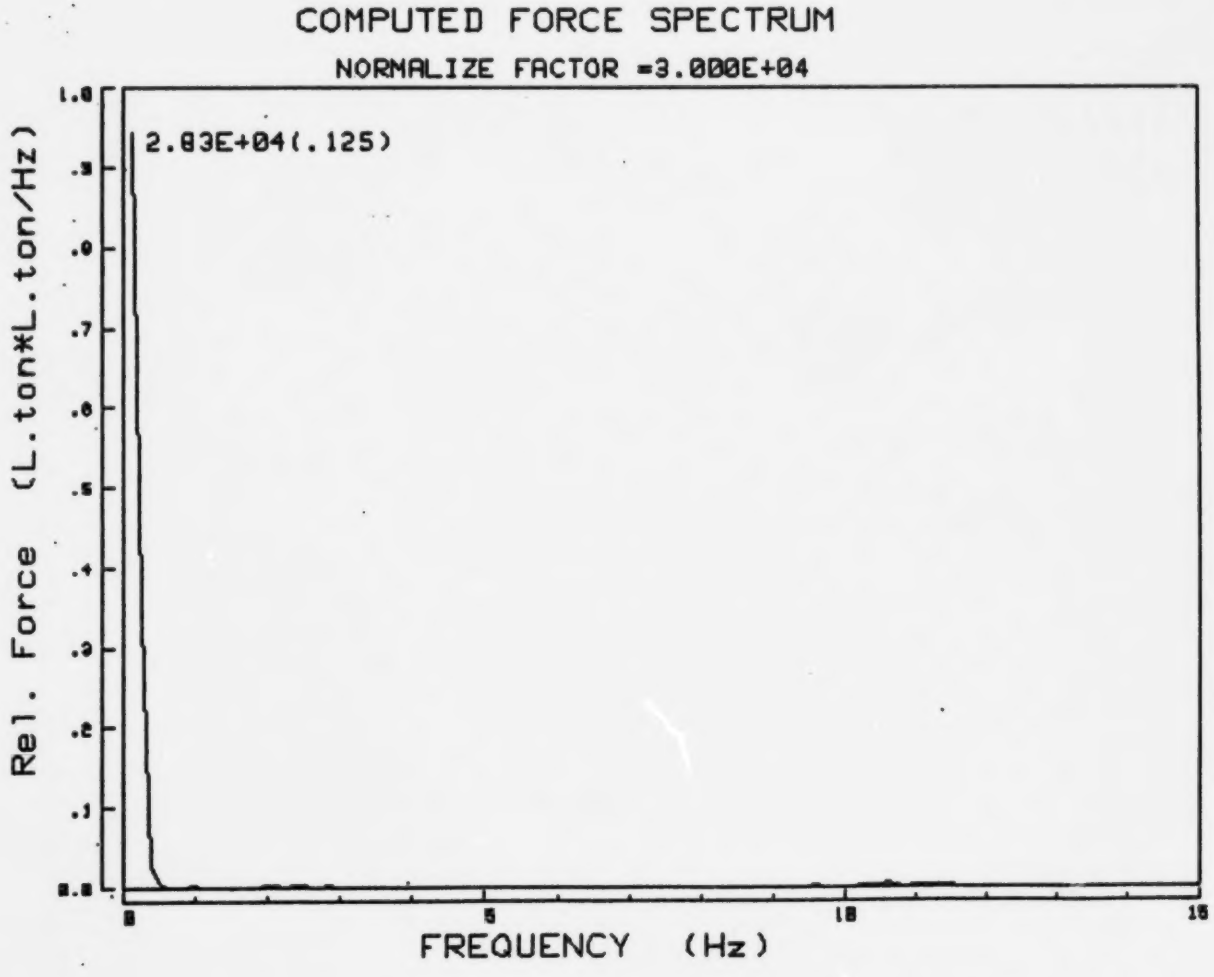


FIGURE 7.3f

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - FULL SCALE TEST - RAMMING MODE
Vessel  : USCGC POLAR SEA                    Test Time:FEB 8 1981 (02:30)
Sensor  : ACC. 7Y                            Cal.Factor: 1.227('g/v)
FreqRange:    50 (Hz)                        Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending                File Name: F87Y1
* Location of applied conc. load is at section # 18.5
* Cut-off frequency for force calculation is 15 (Hz)
```

```
Mean        Square= 1.773550E+04(L.ton*L.ton)
Root Mean Square= 1.331747E+02(L.ton)
```

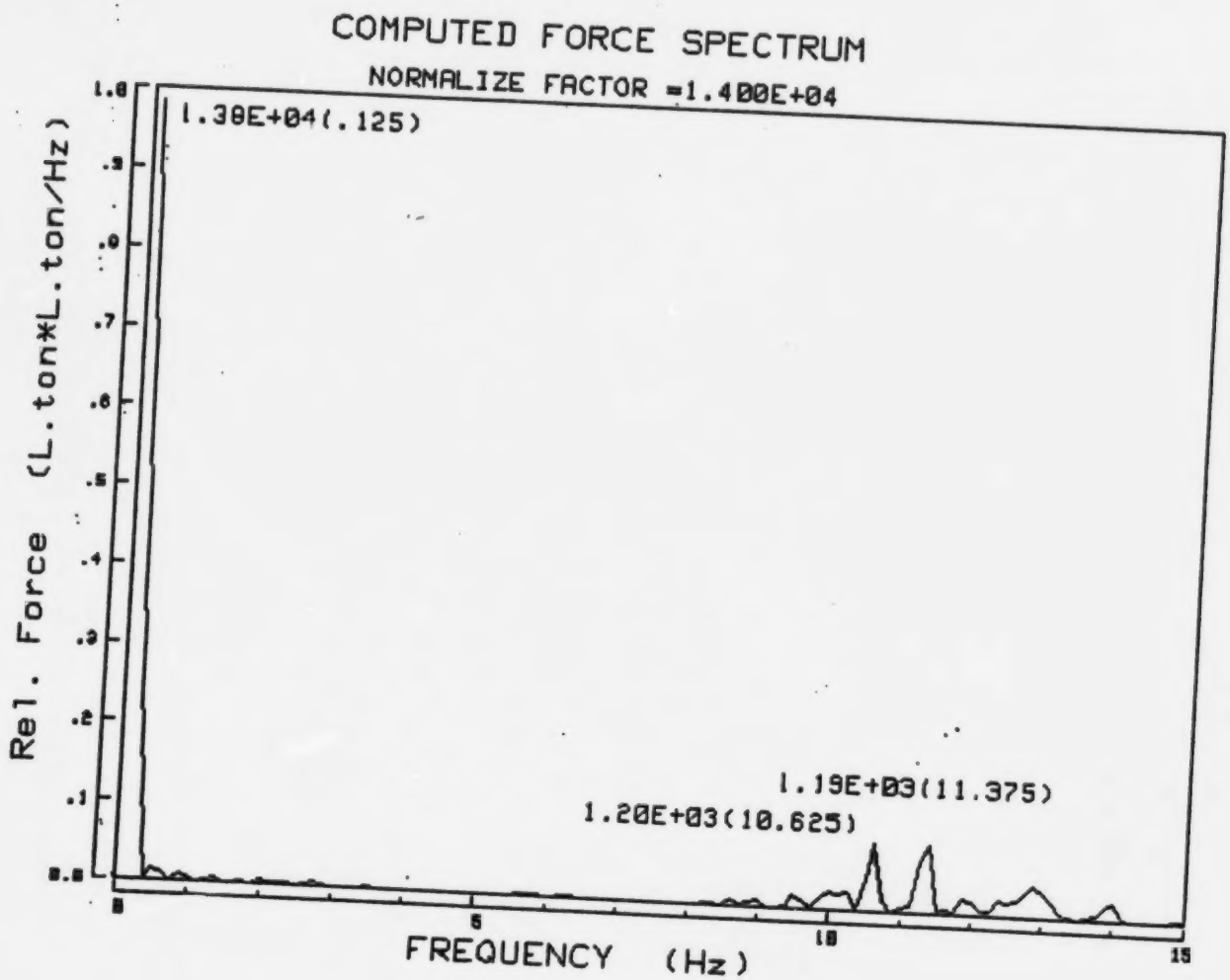


FIGURE 7.3g

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - FULL SCALE TEST - RAMMING MODE
Vessel  : USCGC POLAR SEA                  Test Time:FEB 8 1981 (02:30)
Sensor  : BOW HEAVE                        Cal.Factor: 1.250('g/v)
FreqRange:    50 (Hz)                      Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending                File Name: F81Z1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 20
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.842607E+04(L.ton*L.ton)
  Root Mean Square= 1.357427E+02(L.ton)
```

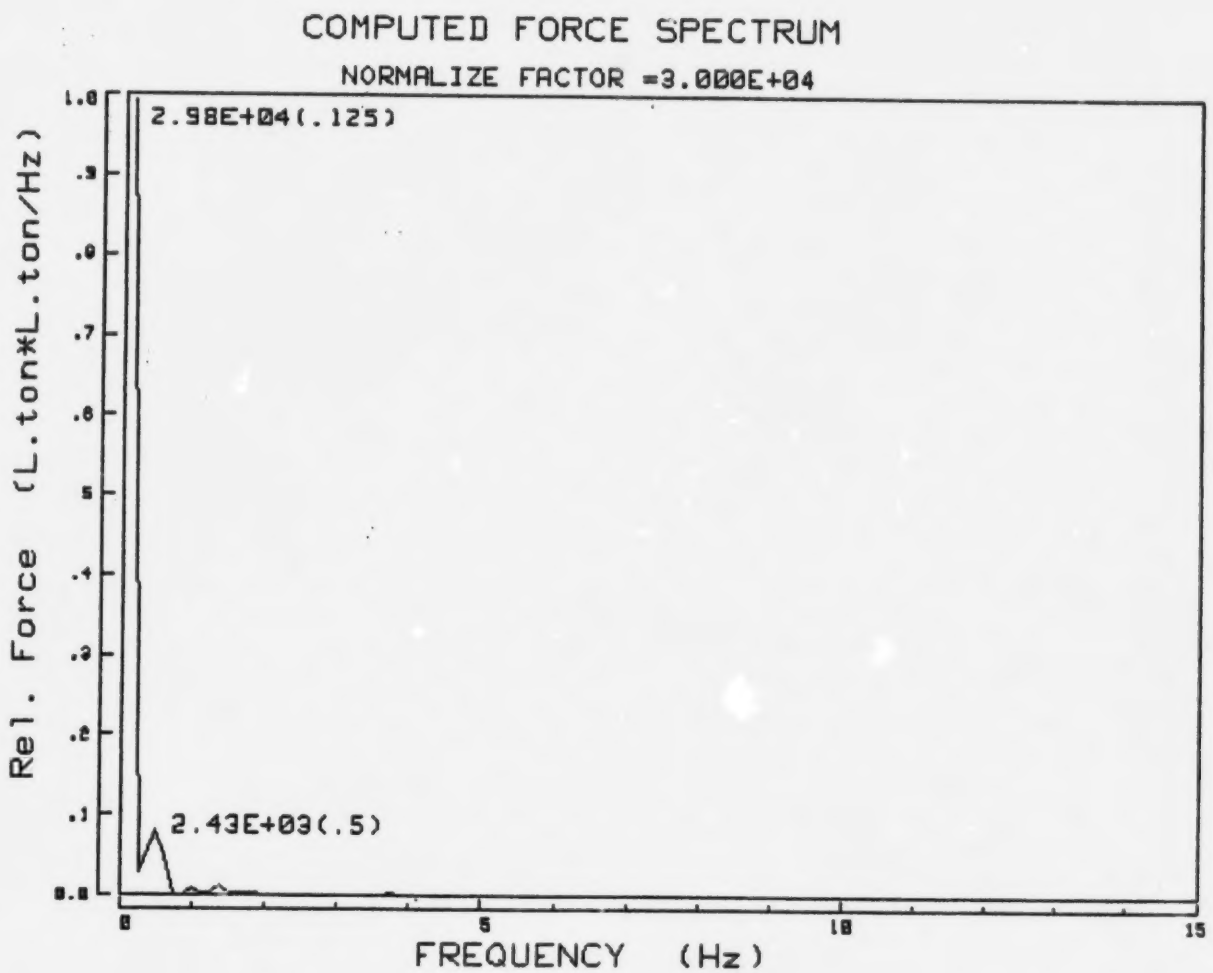


FIGURE 7.3h

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - FULL SCALE TEST - RAMMING MODE
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (02:30)
Sensor  : ACC. 2Z                        Cal.Factor: 1.250('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F82Z1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)
```

Mean Square= 3.398194E+04(L.ton*L.ton)
Root Mean Square= 1.843419E+02(L.ton)

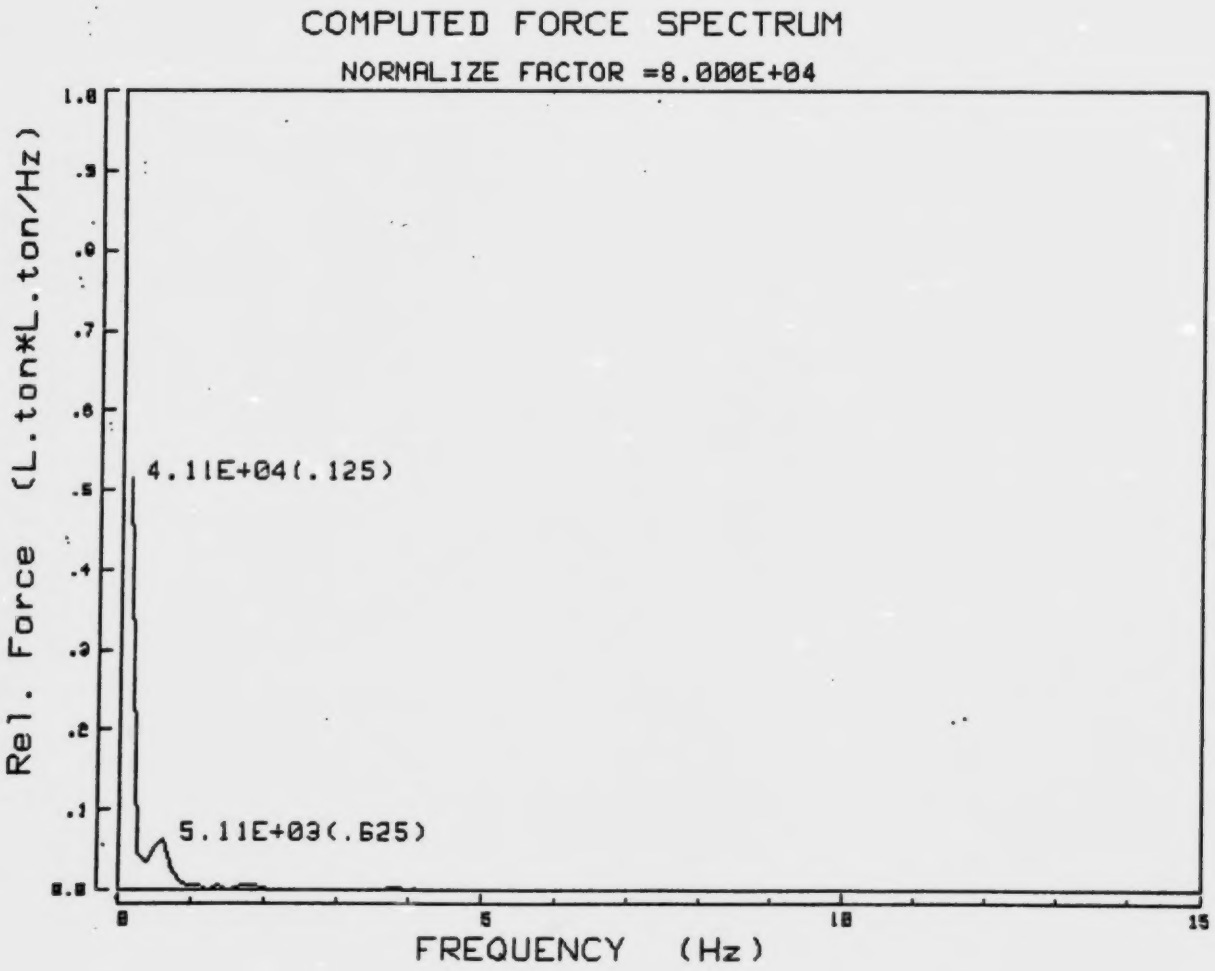


FIGURE 7.3i

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - FULL SCALE TEST - RAMMING MODE
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (02:30)
Sensor  : ACC. 5Z                        Cal.Factor: 1.242('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F85Z1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

Mean Square= 8.038722E+03(L.ton*L.ton)
Root Mean Square= 8.965892E+01(L.ton)

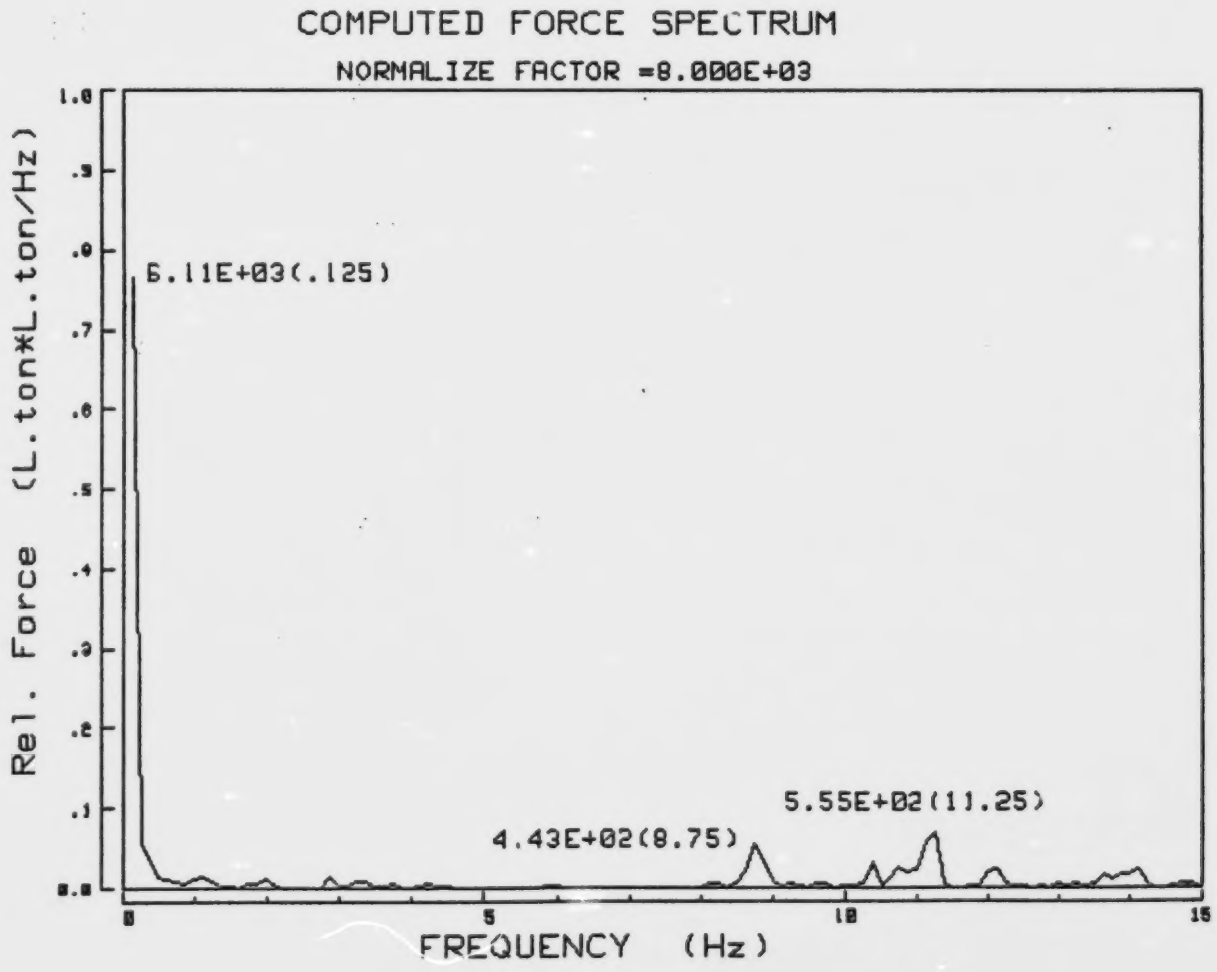


FIGURE 7.3j

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - FULL SCALE TEST - RAMMING MODE
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (02:30)
Sensor  : ACC. 7Z                        Cal.Factor: 1.235('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F87Z1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.199687E+04(L.ton*L.ton)
  Root Mean Square= 1.095302E+02(L.ton)
```

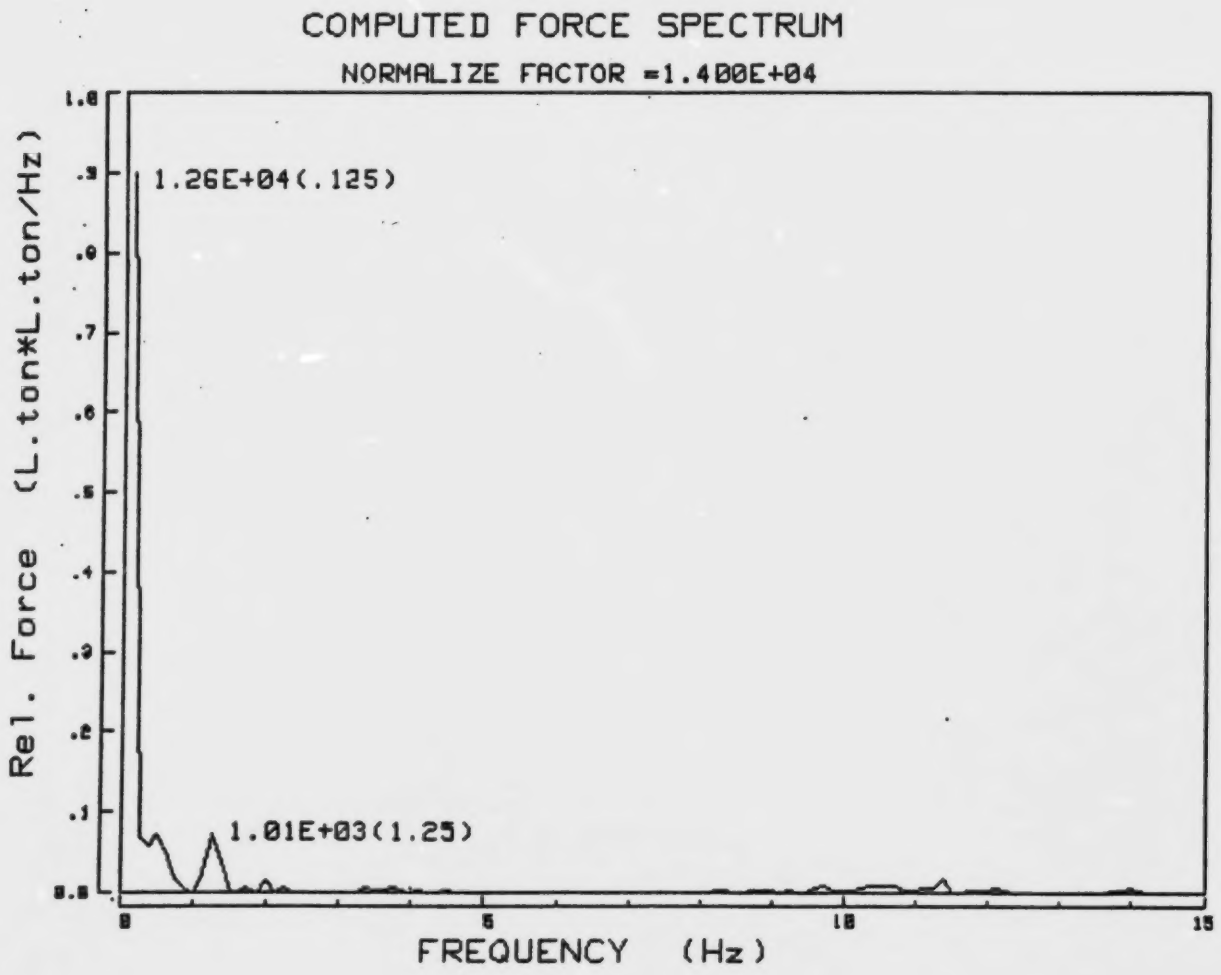


FIGURE 7.4a

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S TEST - 2' L.I. OBLIQUE B/2 PORT
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (23:50)
Sensor  : BOW SWAY                       Cal.Factor:1.1940('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F81Y2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 20
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.419055E+04(L.ton*L.ton)
  Root Mean Square= 1.191241E+02(L.ton)
```

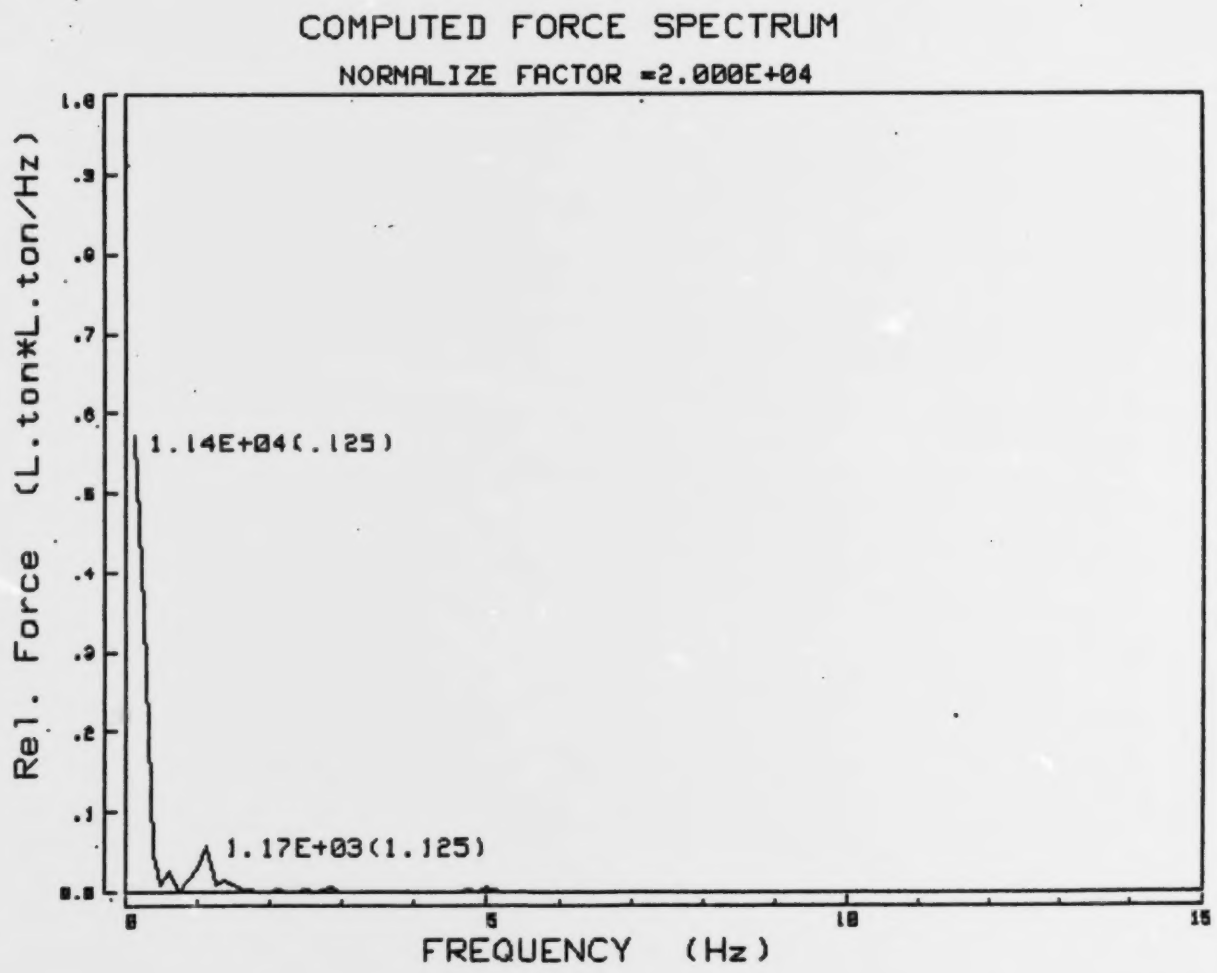


FIGURE 7.4b

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

Subject :USCGC POLAR SEA - F.S TEST - 2' L.I. OBLIQUE B/2 PORT
Vessel : USCGC POLAR SEA Test Time:FEB 8 1981 (23:50)
Sensor : ACC. 2Y Cal.Factor:1.2739('g/v)
FreqRange: 50 (Hz) Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending File Name: F82Y2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)

Mean Square= 1.925015E+04(L.ton*L.ton)
Root Mean Square= 1.387449E+02(L.ton)

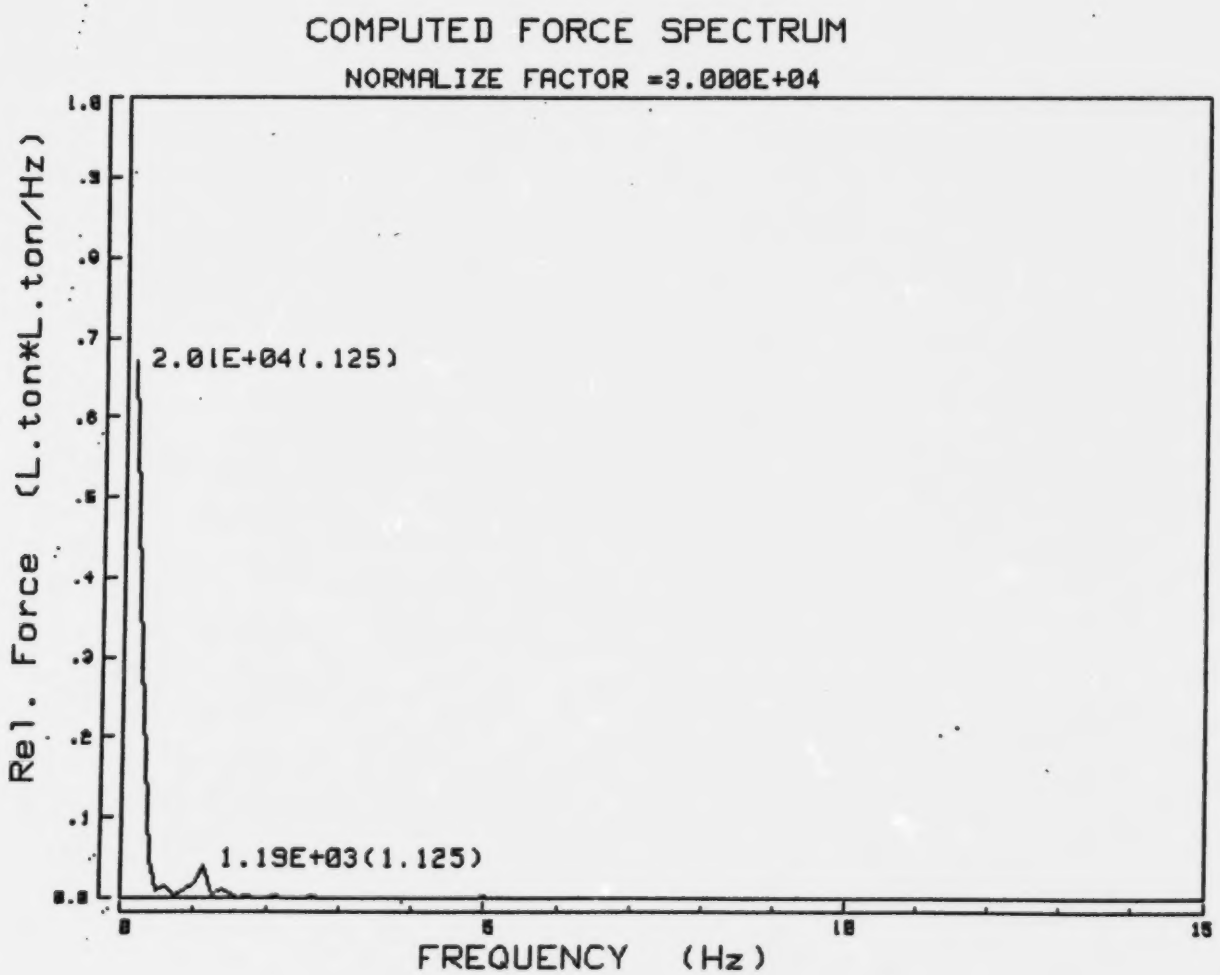


FIGURE 7.4c

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S TEST - 2' L.I. OBLIQUE B/2 PORT
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (23:50)
Sensor  : ACC. 3Y                        Cal.Factor:1.2195('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F83Y2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 16.14
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 8.040543E+03(L.ton*L.ton)
  Root Mean Square= 8.966908E+01(L.ton)
```

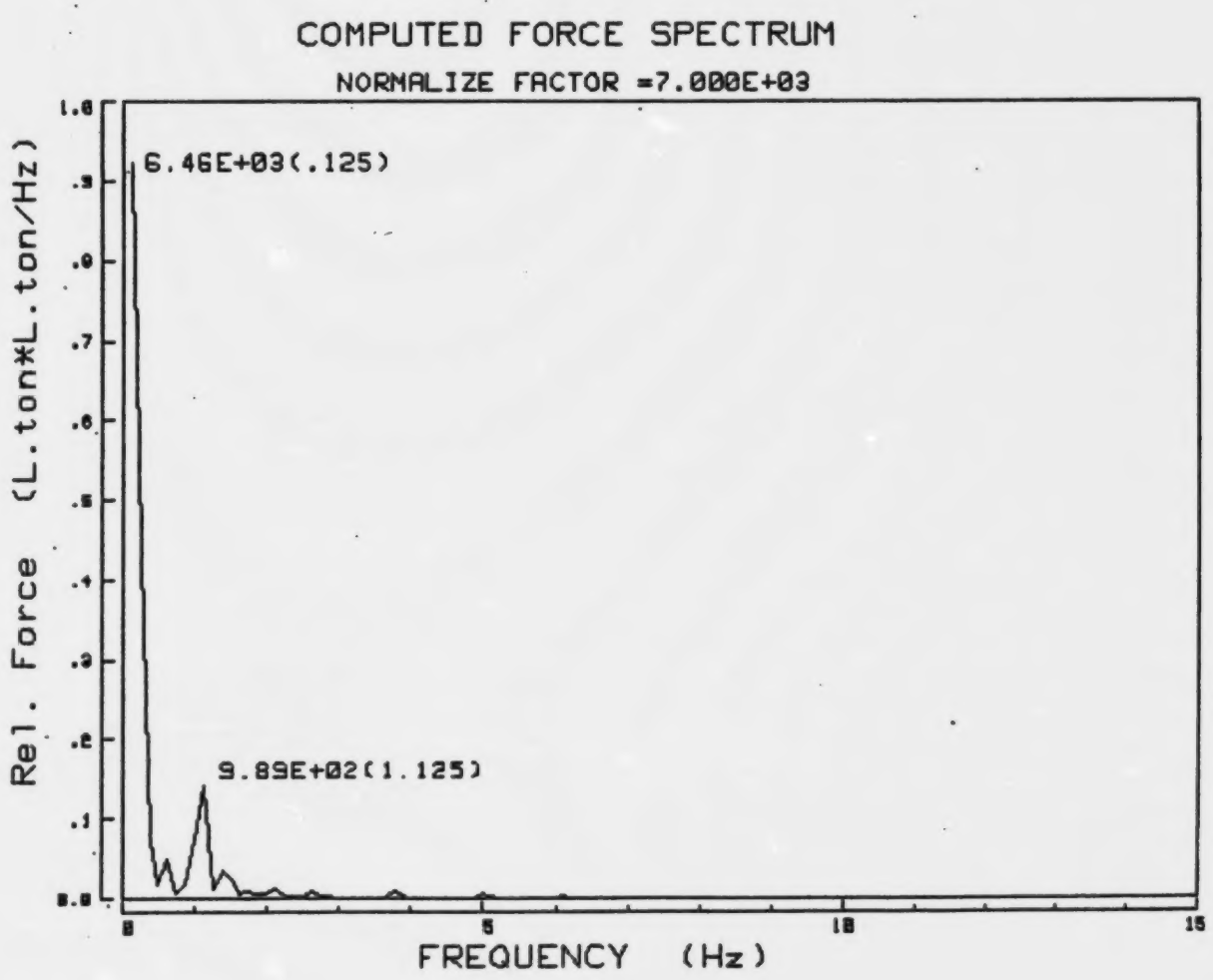


FIGURE 7.4d

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S. TEST - 2' L.I. OBLIQUE B/2 PORT
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (23:50)
Sensor  : ACC. 5Y                        Cal.Factor:1.2270('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F85Y2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 2.163917E+04(L.ton*L.ton)
  Root Mean Square= 1.471026E+02(L.ton)
```

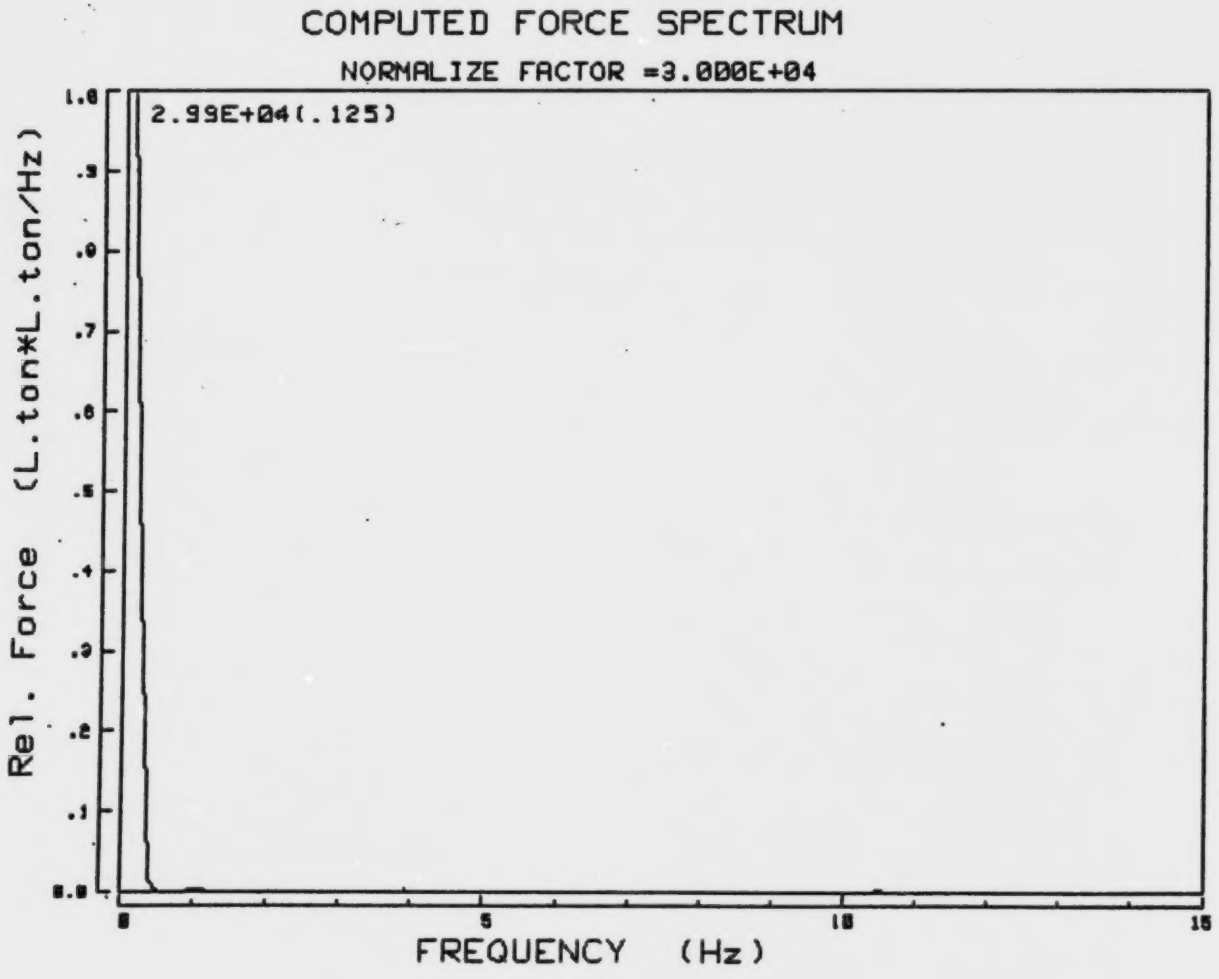


FIGURE 7.4e

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S. TEST - 2' L.I. OBLIQUE B/2 PORT
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (23:50)
Sensor  : ACC. 6Y                        Cal.Factor:1.2422('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F86Y2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 6.348052E+03(L.ton*L.ton)
  Root Mean Square= 7.967466E+01(L.ton)
```

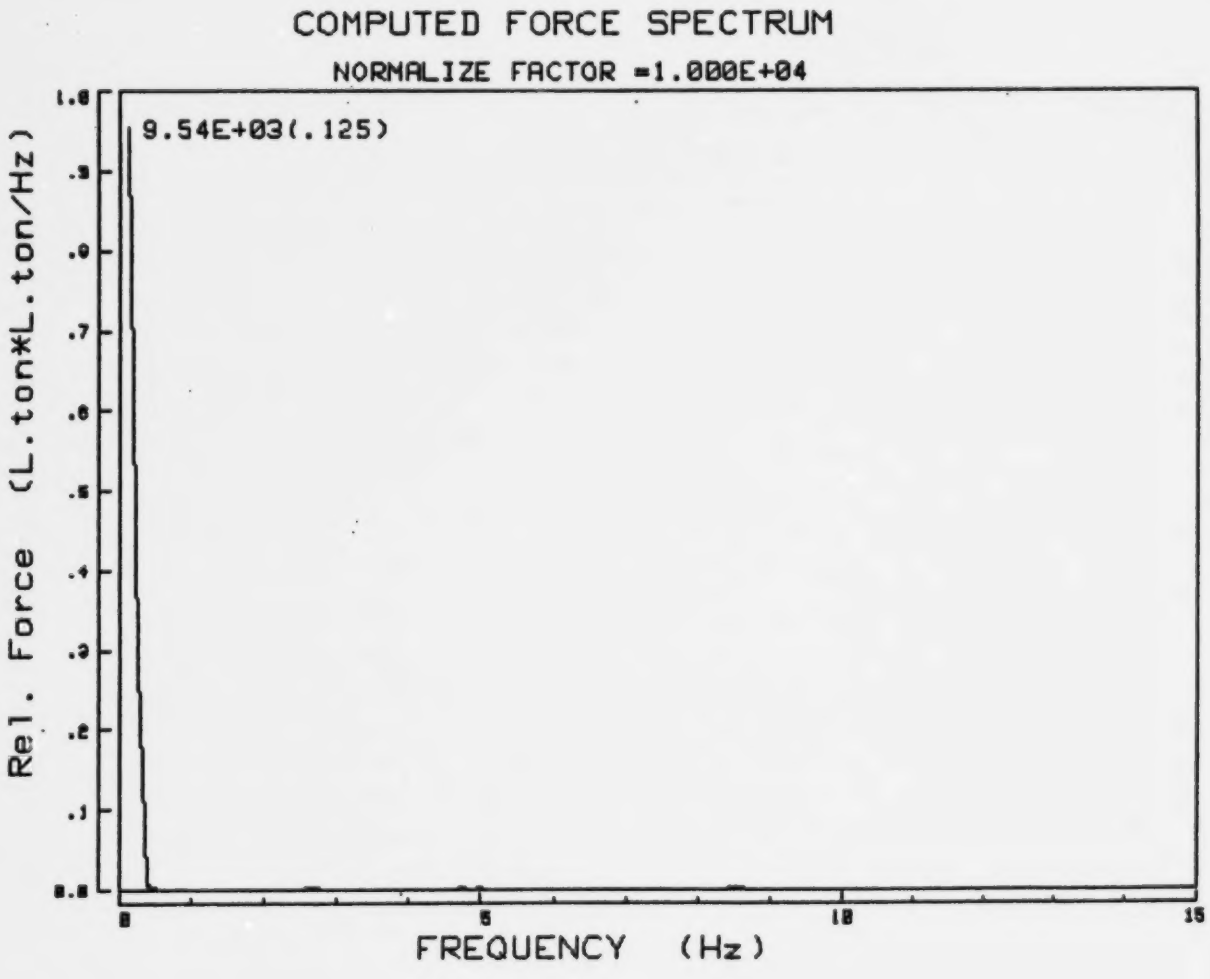


FIGURE 7.4f

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

Subject :USCGC POLAR SEA - F.S. TEST - 2' L.I. OBLIQUE B/2 PORT
Vessel : USCGC POLAR SEA Test Time:FEB 8 1981 (23:50)
Sensor : ACC. 7Y Cal.Factor:1.2270('g/v)
FreqRange: 50 (Hz) Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending File Name: F87Y2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)

Mean Square= 7.173796E+03(L.ton*L.ton)
Root Mean Square= 8.469827E+01(L.ton)

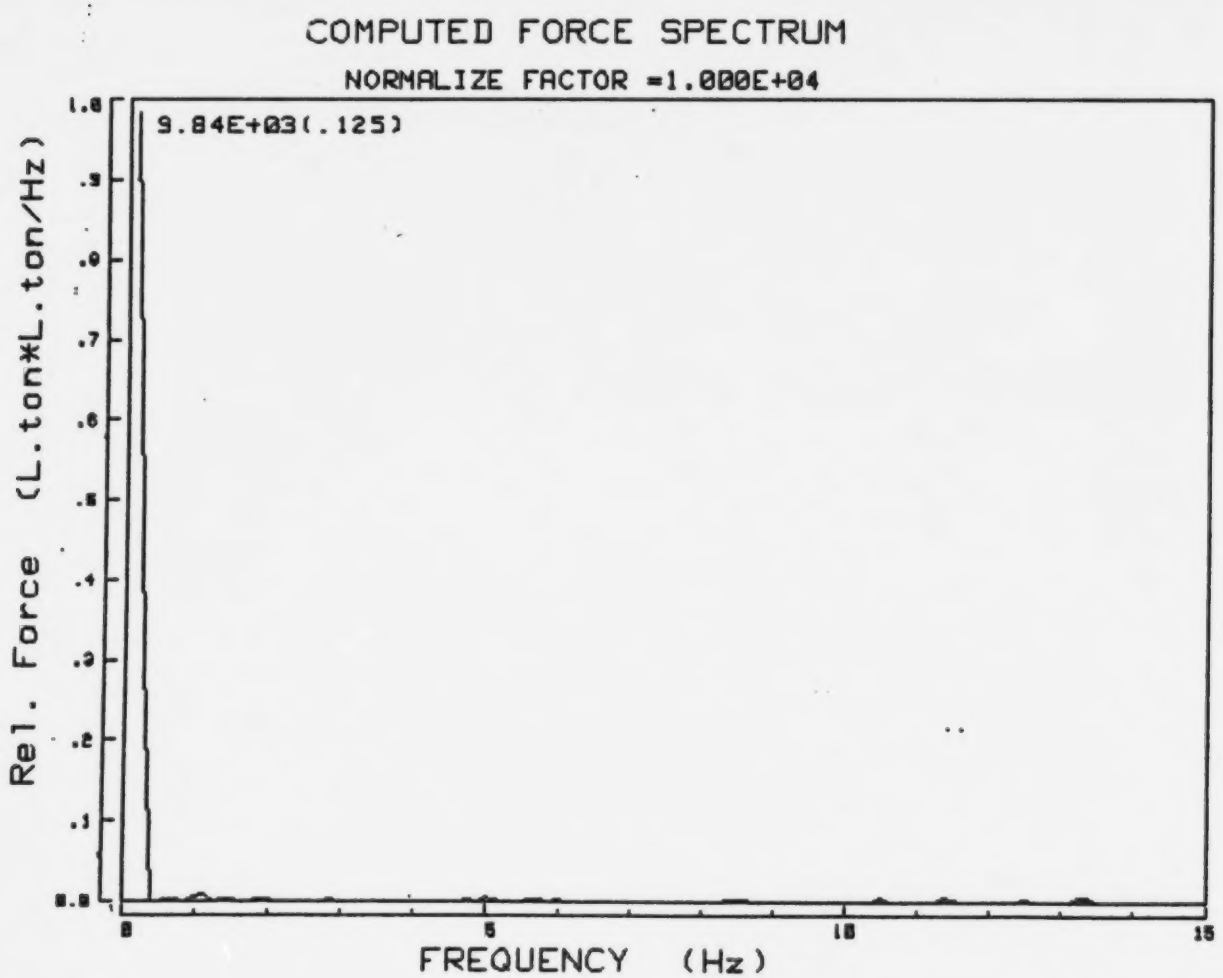


FIGURE 7.4g

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S TEST - 2' L.I. OBLIQUE B/2 PORT
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (23:50)
Sensor  : BOW HEAVE                      Cal.Factor:1.2500('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F81Z2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 20
* Cut-off frequency for force calculation is 15 (Hz)
```

Mean Square= 6.690572E+03(L.ton*L.ton)
Root Mean Square= 8.179592E+01(L.ton)

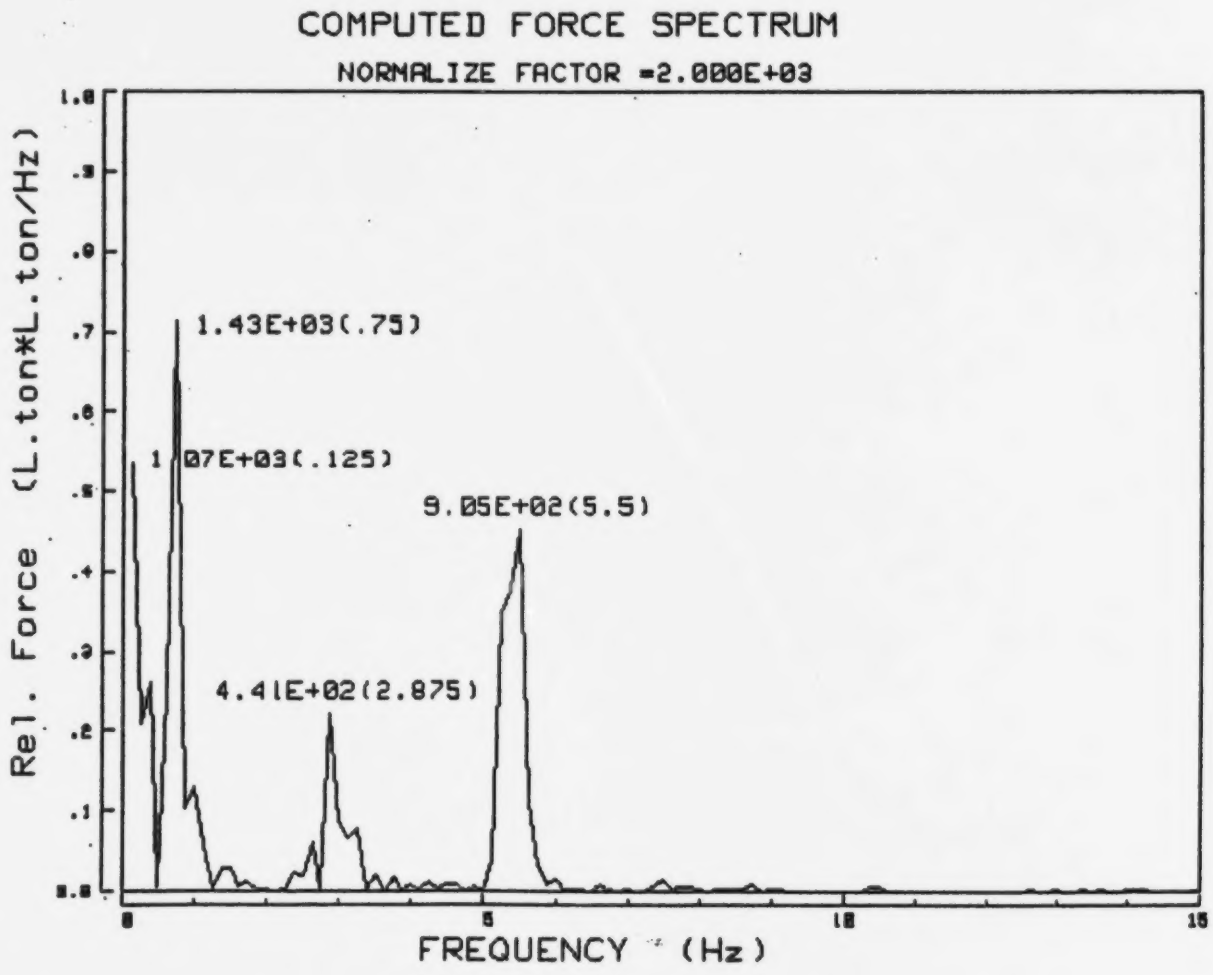


FIGURE 7.4h

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S TEST - 2' L.I. OBLIQUE B/2 PORT
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (23:50)
Sensor  : ACC. 2Z                        Cal.Factor:1.2500('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F82Z2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.484612E+04(L.ton*L.ton)
  Root Mean Square= 1.218447E+02(L.ton)
```

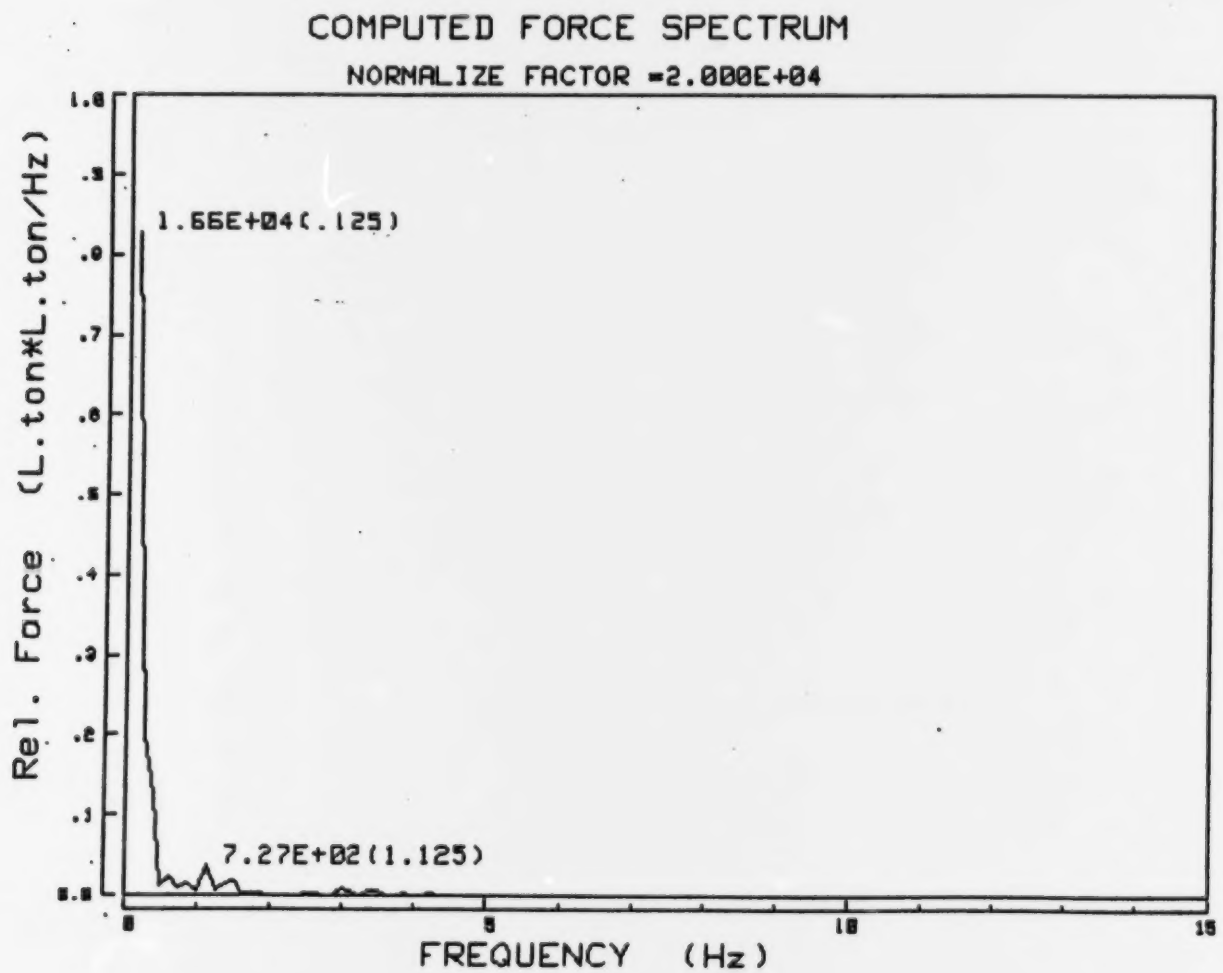


FIGURE 7.4i

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

Subject :USCGC POLAR SEA - F.S. TEST - 2' L.I. OBLIQUE B/2 PORT
Vessel : USCGC POLAR SEA
Sensor : ACC. 5Z
FreqRange: 50 (Hz)
Vib. Mode: Vertical Bending
Test Time:FEB 8 1981 (23:50)
Cal.Factor:1.2422('g/v)
Force Unit: L.ton*L.ton/Hz
File Name: F85Z2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)

Mean Square= 2.421446E+03(L.ton*L.ton)
Root Mean Square= 4.920819E+01(L.ton)

COMPUTED FORCE SPECTRUM

NORMALIZE FACTOR =1.000E+03

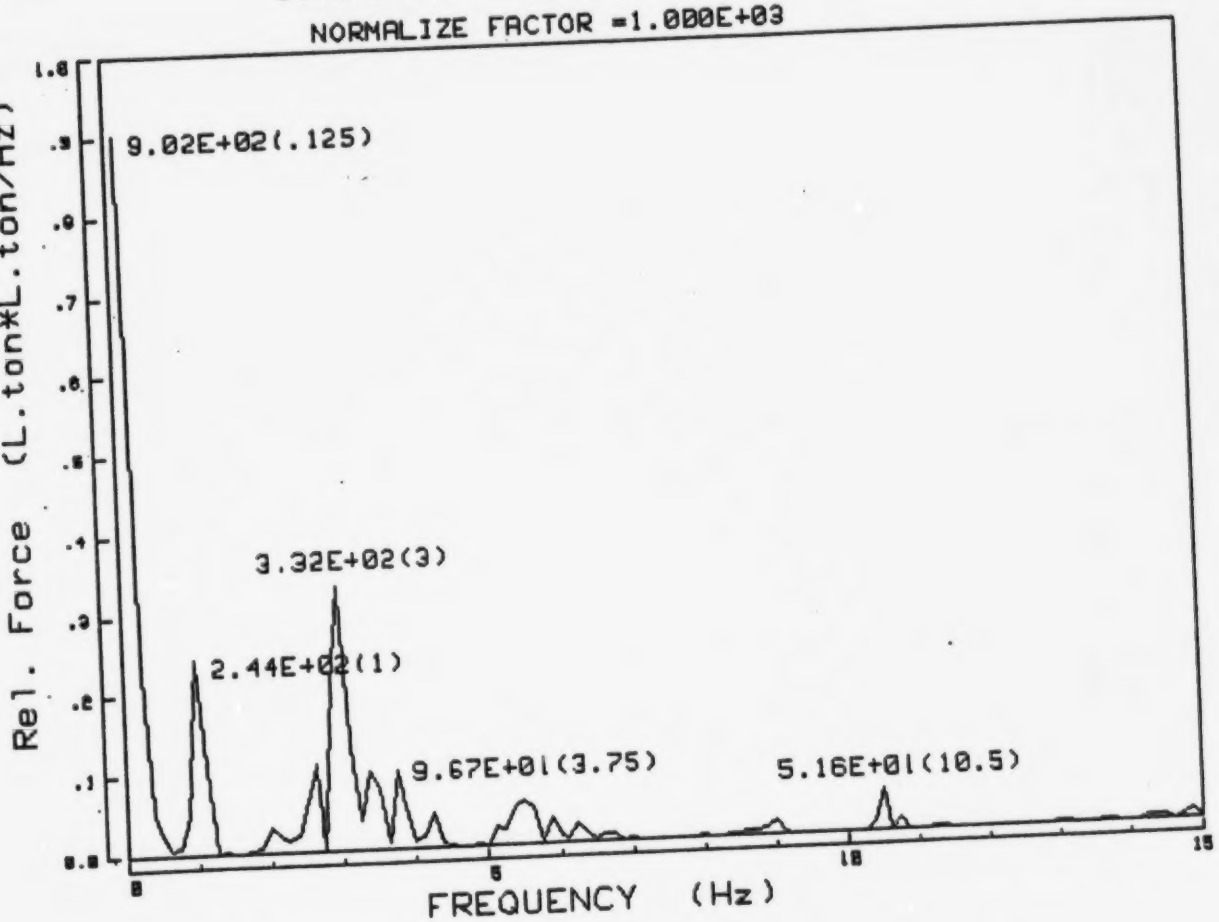


FIGURE 7.4j

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S. TEST - 2' L.I. OBLIQUE B/2 PORT
Vessel  : USCGC POLAR SEA                Test Time:FEB 8 1981 (23:50)
Sensor  : ACC. 7Z                        Cal.Factor:1.2345('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F87Z2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)
-------------------------------------------------------------------------------

  Mean      Square= 3.467489E+03(L.ton*L.ton)
  Root Mean Square= 5.888539E+01(L.ton)
-------------------------------------------------------------------------------
```

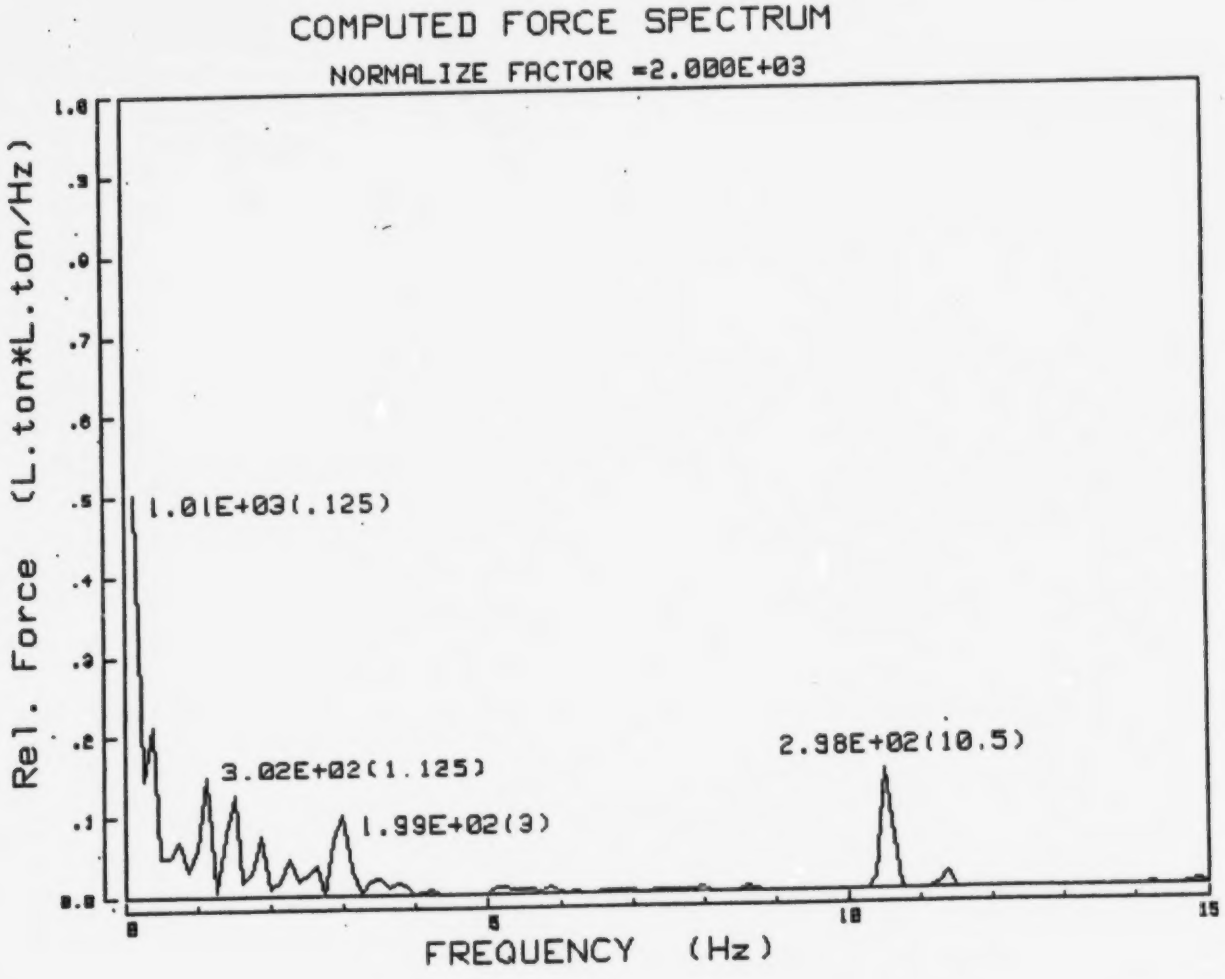


FIGURE 7.5a

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S. TEST - 4'max L.I. RAMMING DEAD-ON
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:08)
Sensor  : BOW SWAY                       Cal.Factor:1.1940('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F91Y0
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 20
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 6.554464E+03(L.ton*L.ton)
  Root Mean Square= 8.095965E+01(L.ton)
```

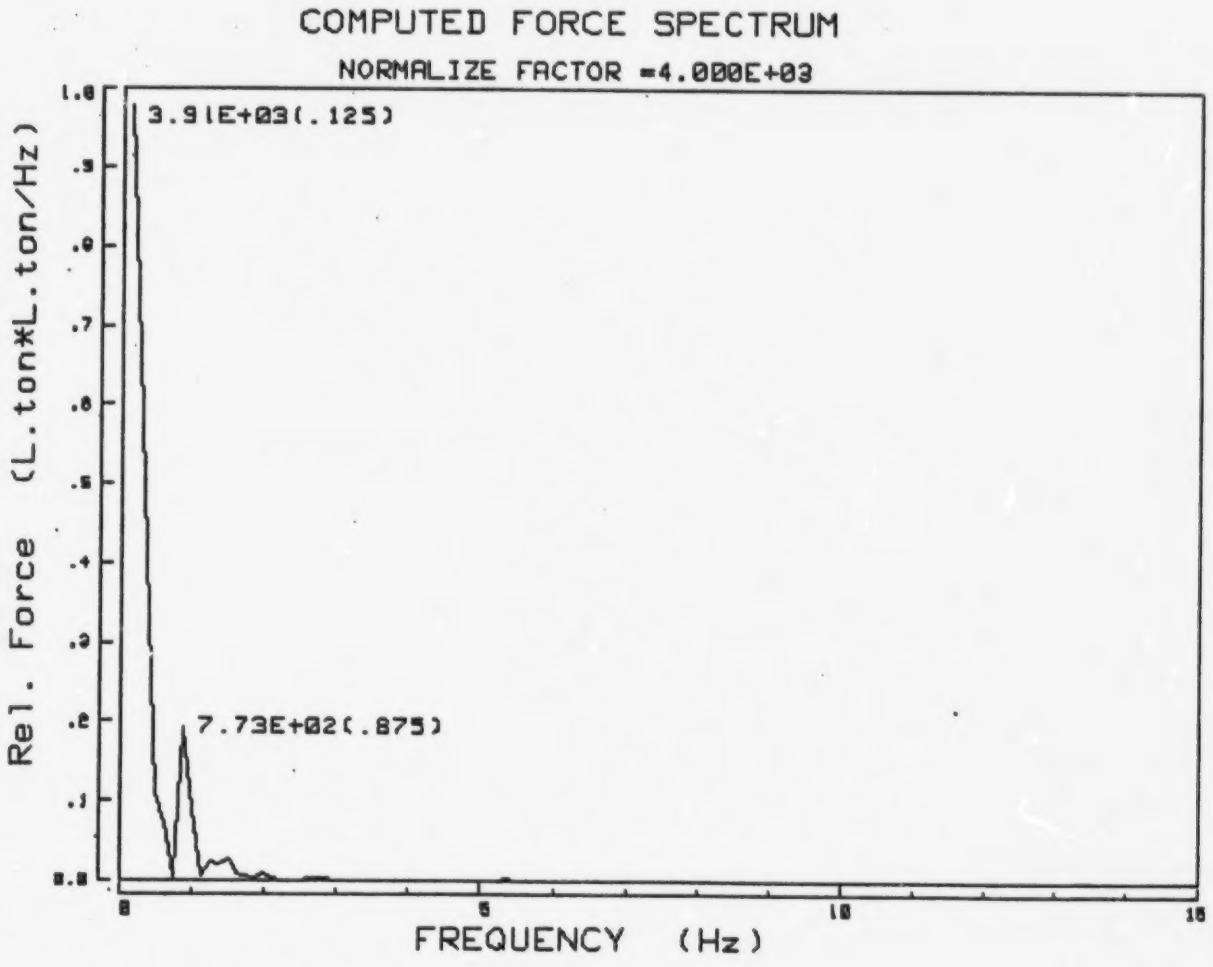


FIGURE 7.5b

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S. TEST - 4'max L.I, RAMMING DEAD-ON
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:08)
Sensor  : ACC. 2Y                        Cal.Factor:1.2739('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F92Y0
* Location of applied conc. load is at section # 20
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 8.935840E+03(L.ton*L.ton)
  Root Mean Square= 9.452957E+01(L.ton)
```

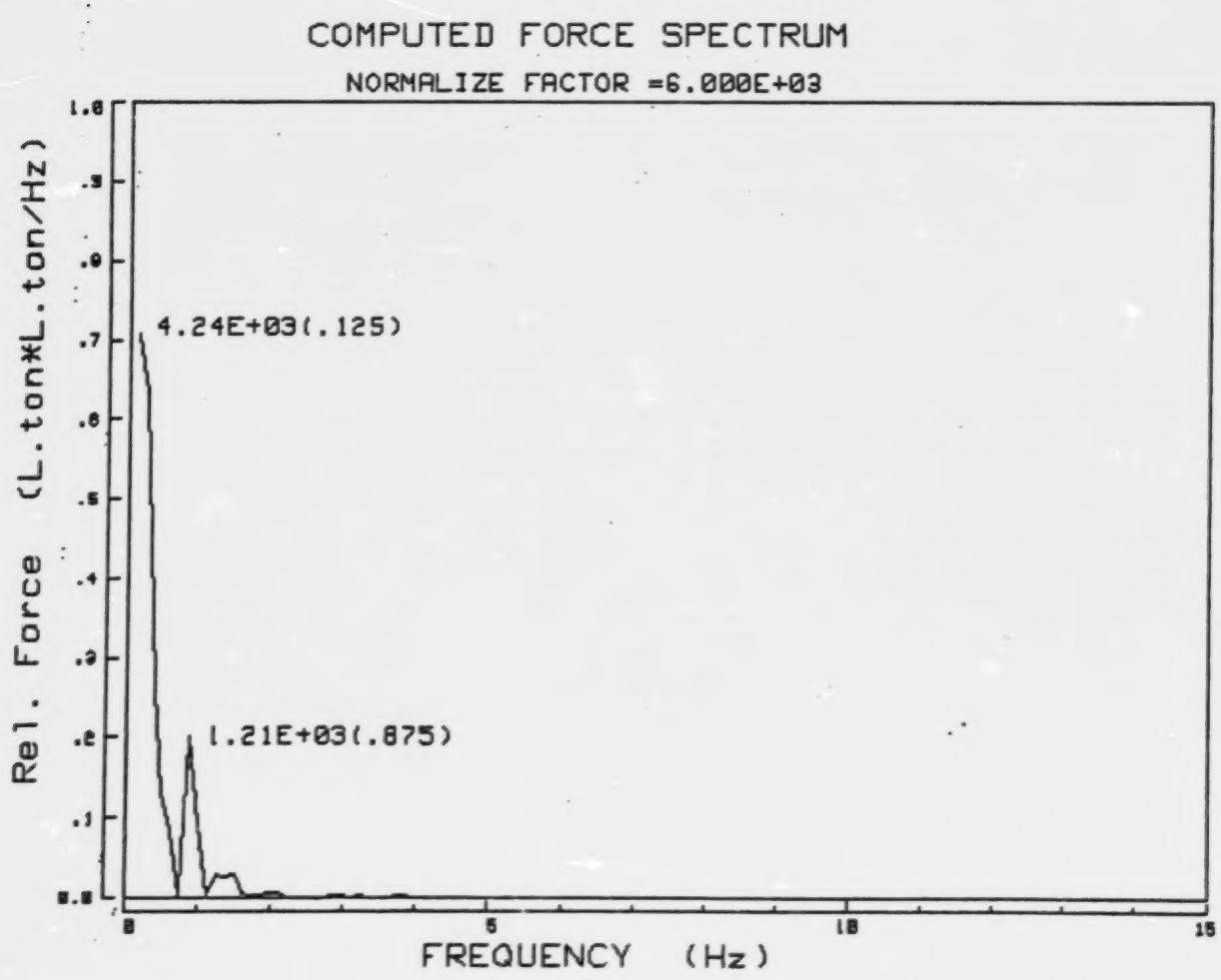


FIGURE 7.5c

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S. TEST - 4'max L.I. RAMMING DEAD-ON
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:08)
Sensor  : ACC. 3Y                        Cal.Factor:1.2195('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F93Y0
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 16.14
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 4.106238E+03(L.ton*L.ton)
  Root Mean Square= 6.407993E+01(L.ton)
```

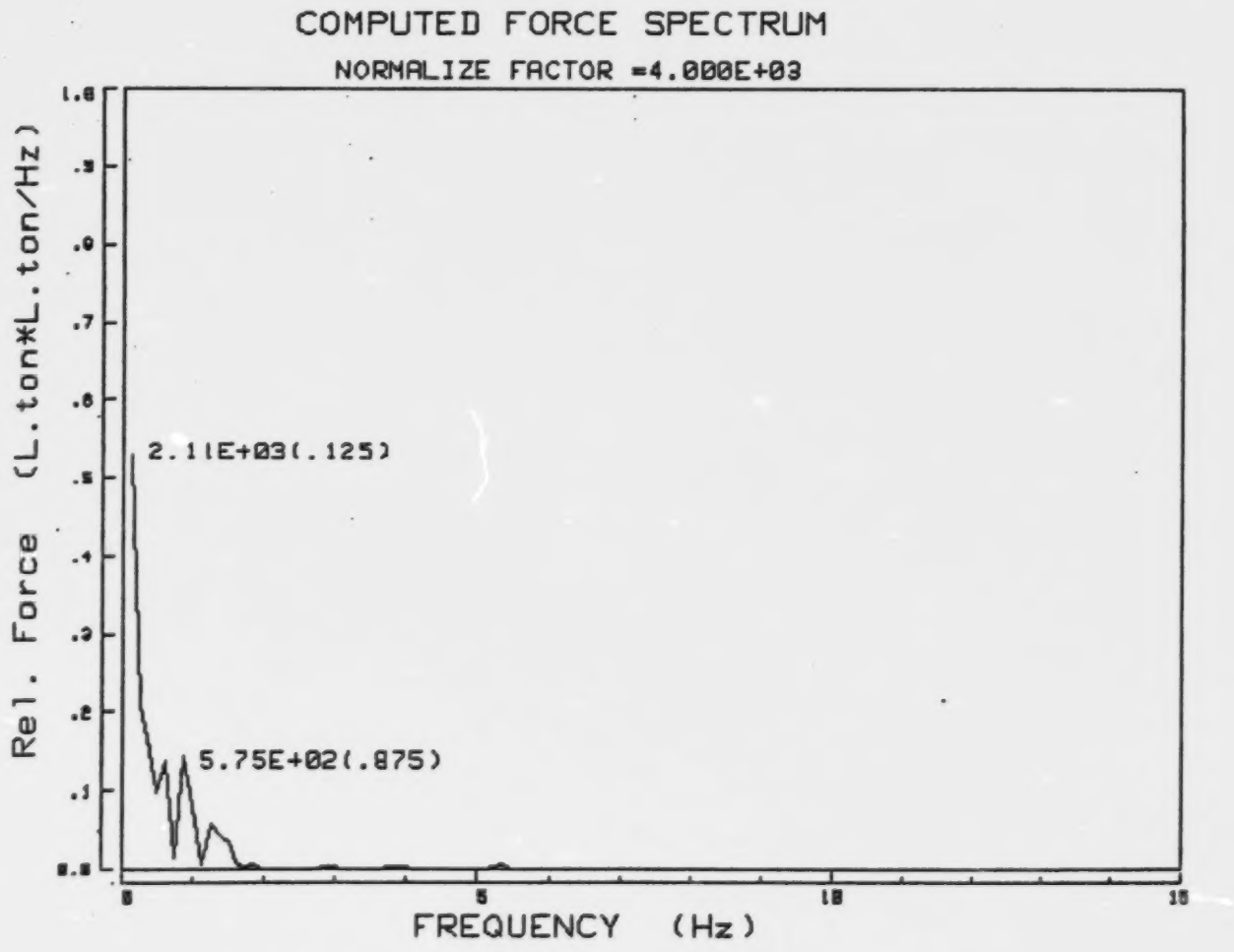


FIGURE 7.5d

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S. TEST - 4'max L.I. RAMMING DEAD-ON
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:08)
Sensor  : ACC. 5Y                        Cal.Factor:1.2270('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F95Y0
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.784521E+03(L.ton*L.ton)
  Root Mean Square= 4.224359E+01(L.ton)
```

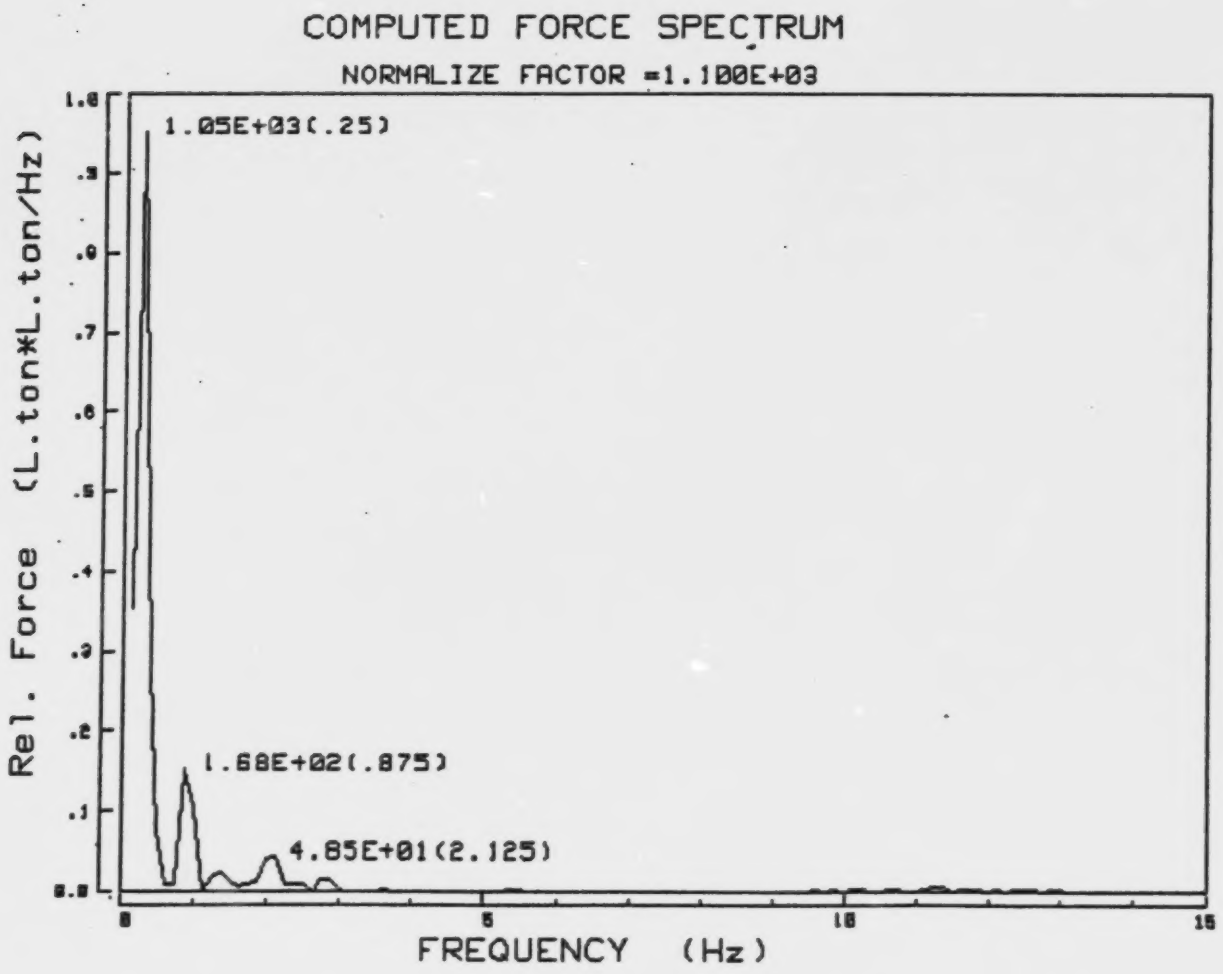


FIGURE 7.5e

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S. TEST - 4'max L.I. RAMMING DEAD-ON
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:08)
Sensor  : ACC. 6Y                        Cal.Factor:1.2422('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F96Y0
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 2.969451E+03(L.ton*L.ton)
  Root Mean Square= 5.449267E+01(L.ton)
```

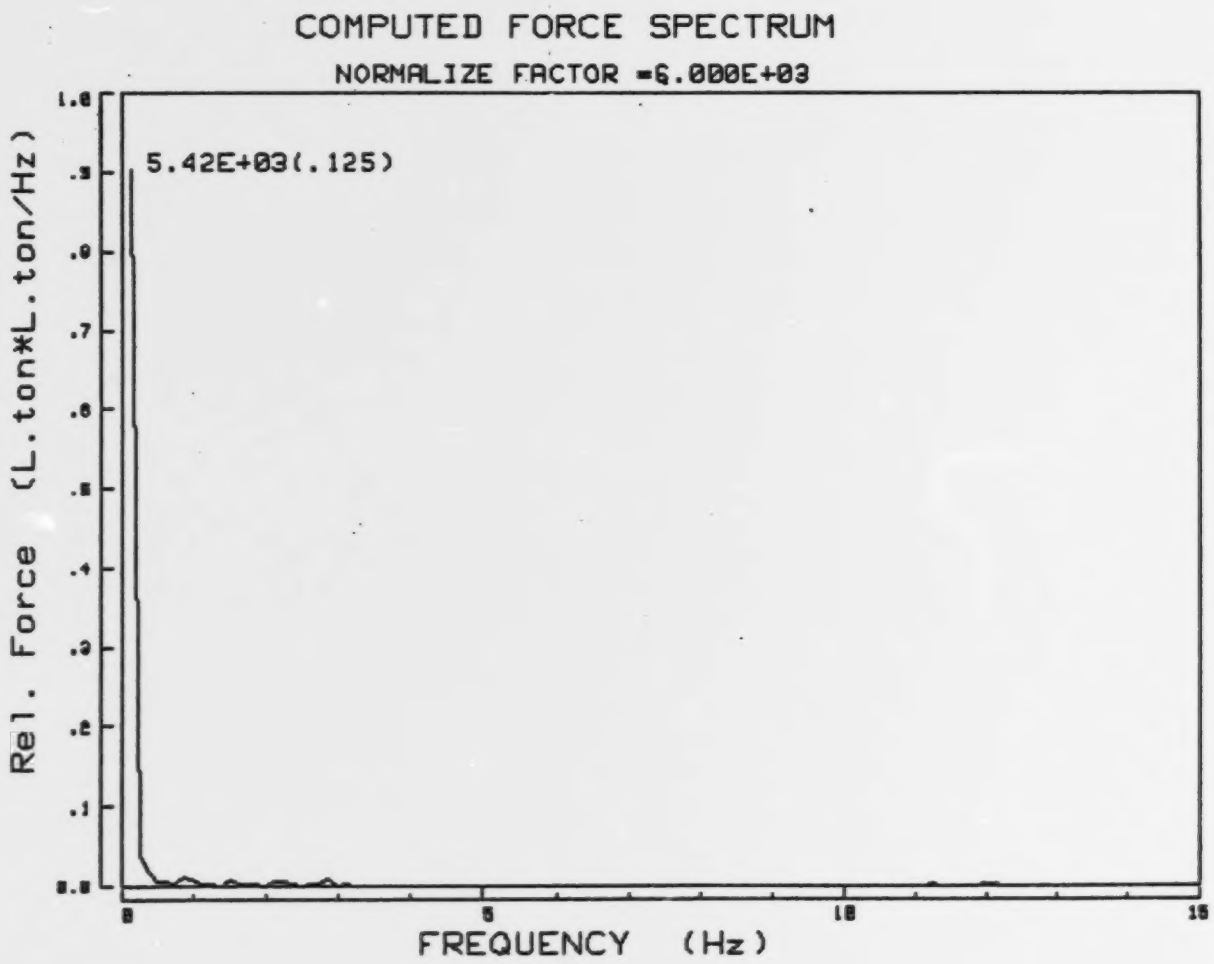


FIGURE 7.5f

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S. TEST - 4'max L.I. RAMMING DEAD-ON
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:08)
Sensor  : ACC. 7Y                        Cal.Factor:1.2270('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F97Y0
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 9.149048E+02(L.ton*L.ton)
  Root Mean Square= 3.024739E+01(L.ton)
```

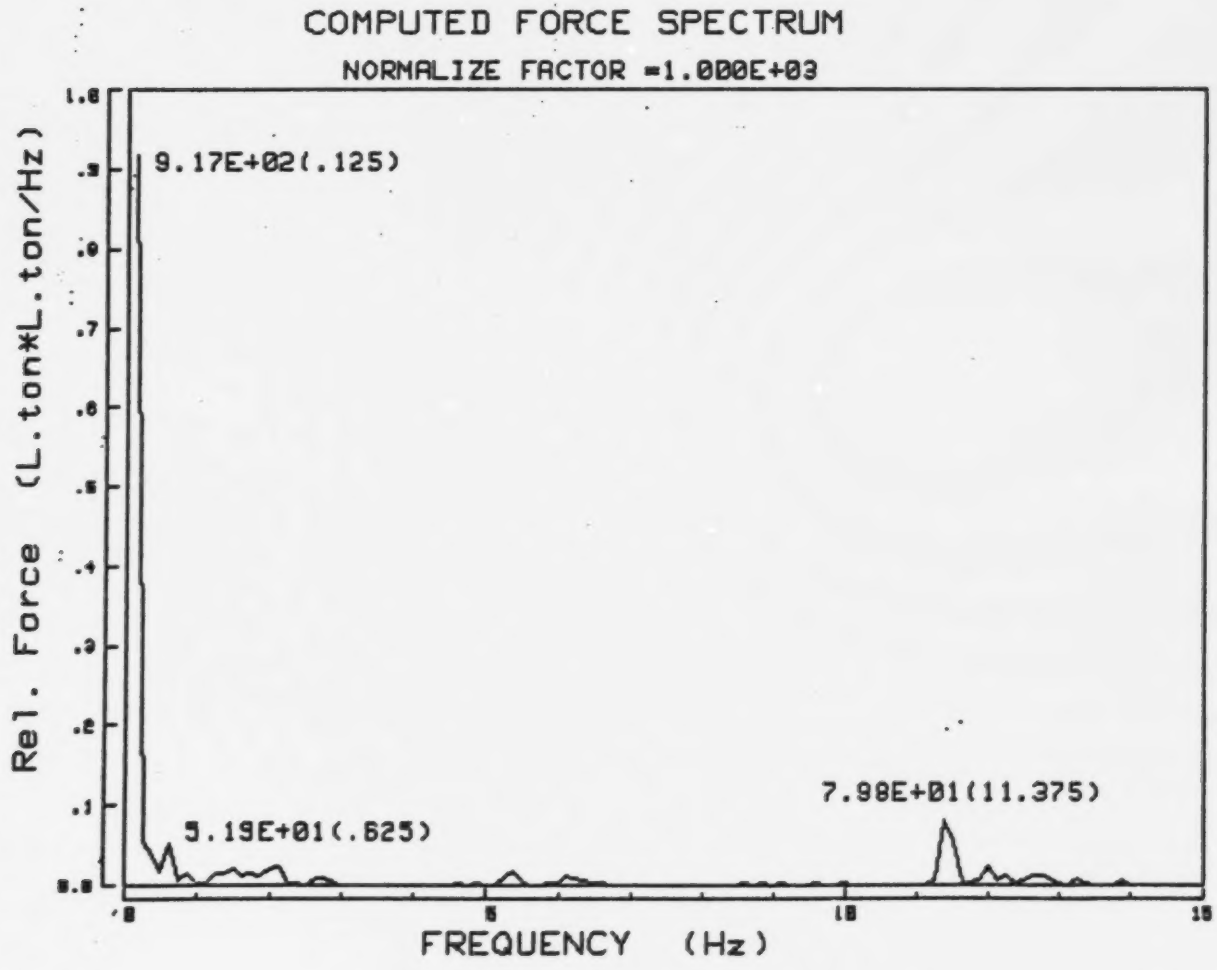


FIGURE 7.5g

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S. TEST - 4'max L.I. RAMMING DEAD-ON
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:08)
Sensor  : BOW HEAVE                      Cal.Factor:1.2500('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F91Z0
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 20
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 9.885525E+03(L.ton*L.ton)
  Root Mean Square= 9.942598E+01(L.ton)
```

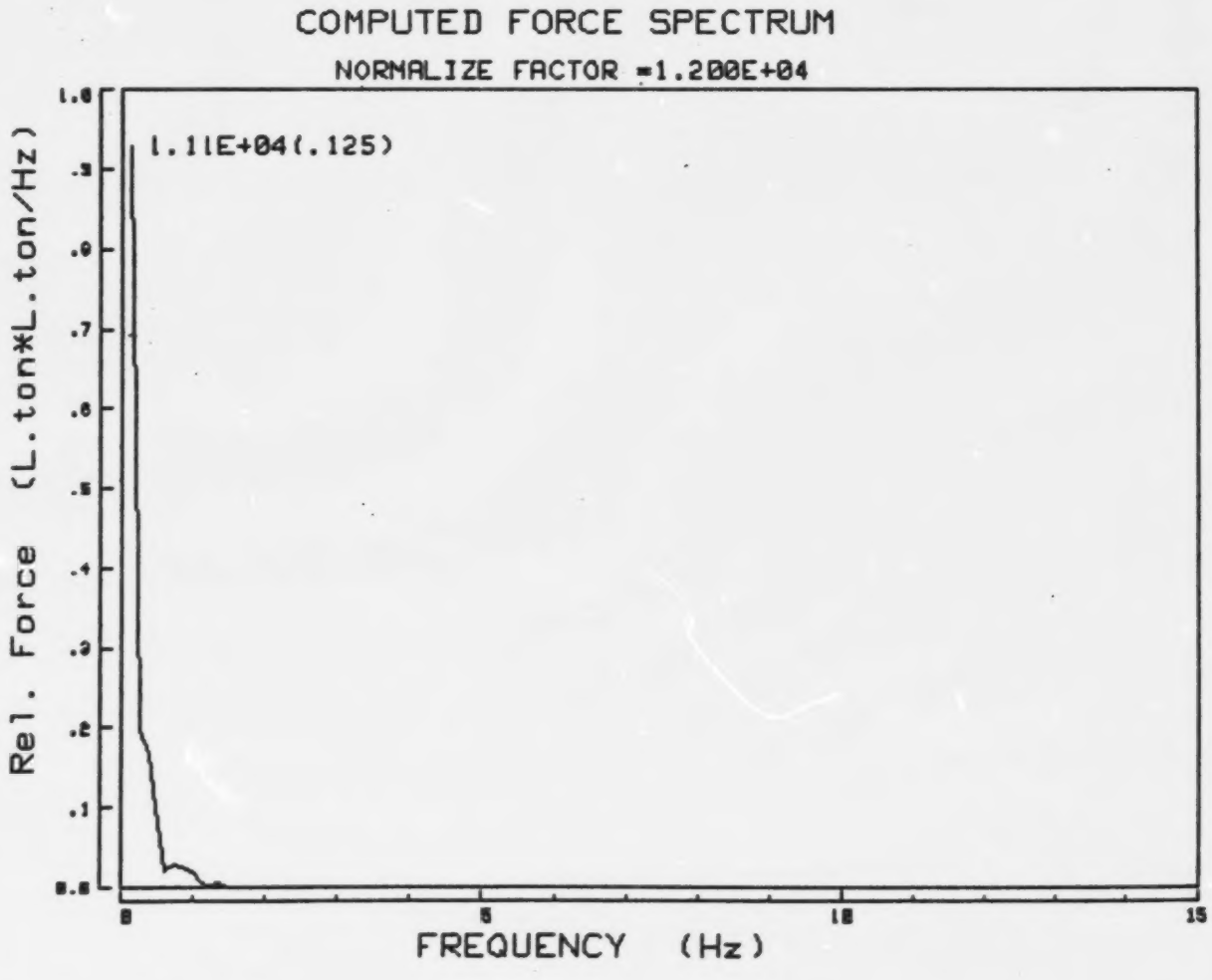


FIGURE 7.5h

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S. TEST - 4'max L.I. RAMMING DEAD-ON
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:08)
Sensor  : ACC. 2Z                        Cal.Factor:1.2500('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F92Z0
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.363959E+04(L.ton*L.ton)
  Root Mean Square= 1.167887E+02(L.ton)
```

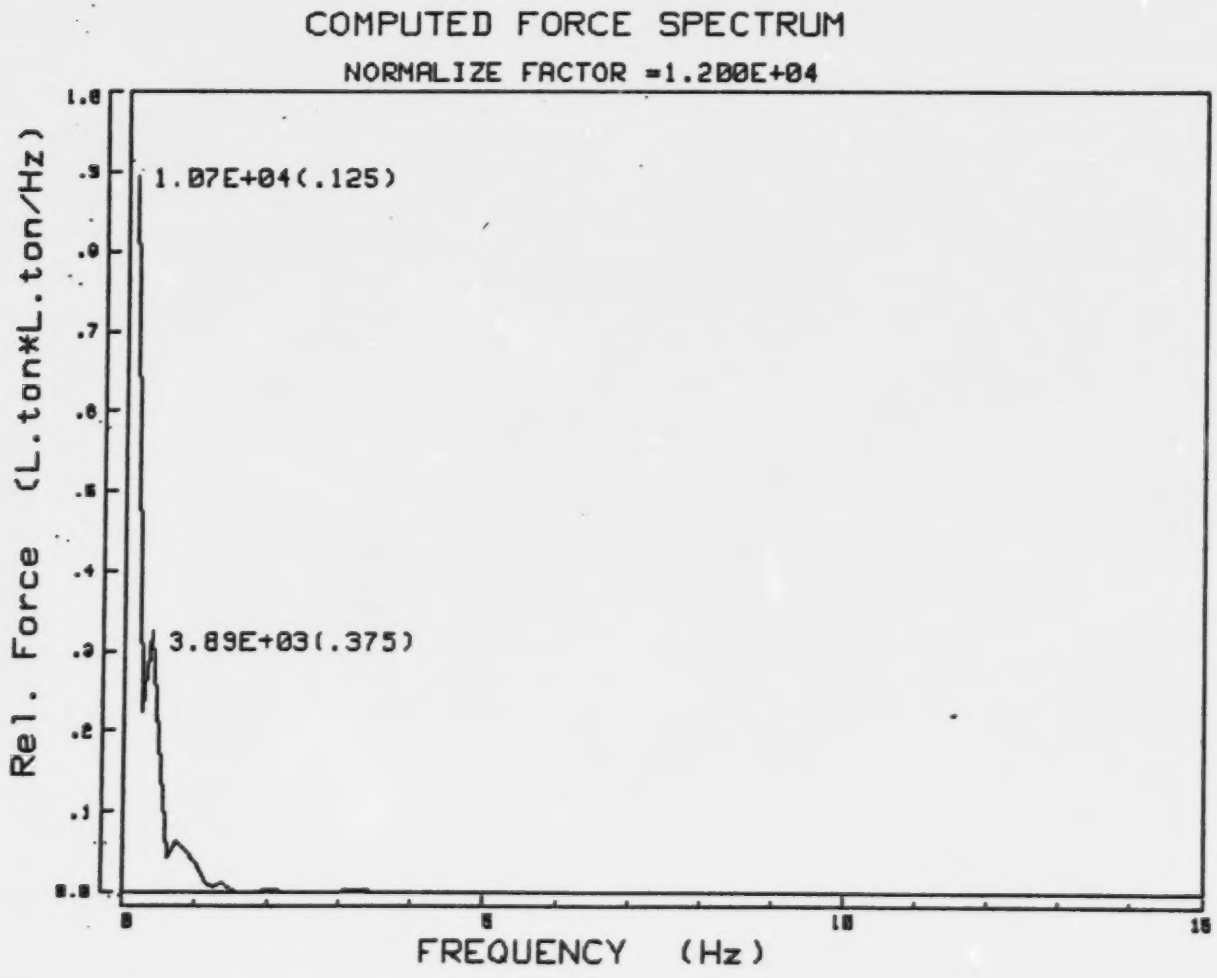


FIGURE 7.5i

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S. TEST - 4'max L.I. RAMMING DEAD-ON
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:08)
Sensor  : ACC. 5Z                        Cal.Factor:1.2422('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F95Z0
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 8.984146E+02(L.ton*L.ton)
  Root Mean Square= 2.997357E+01(L.ton)
```

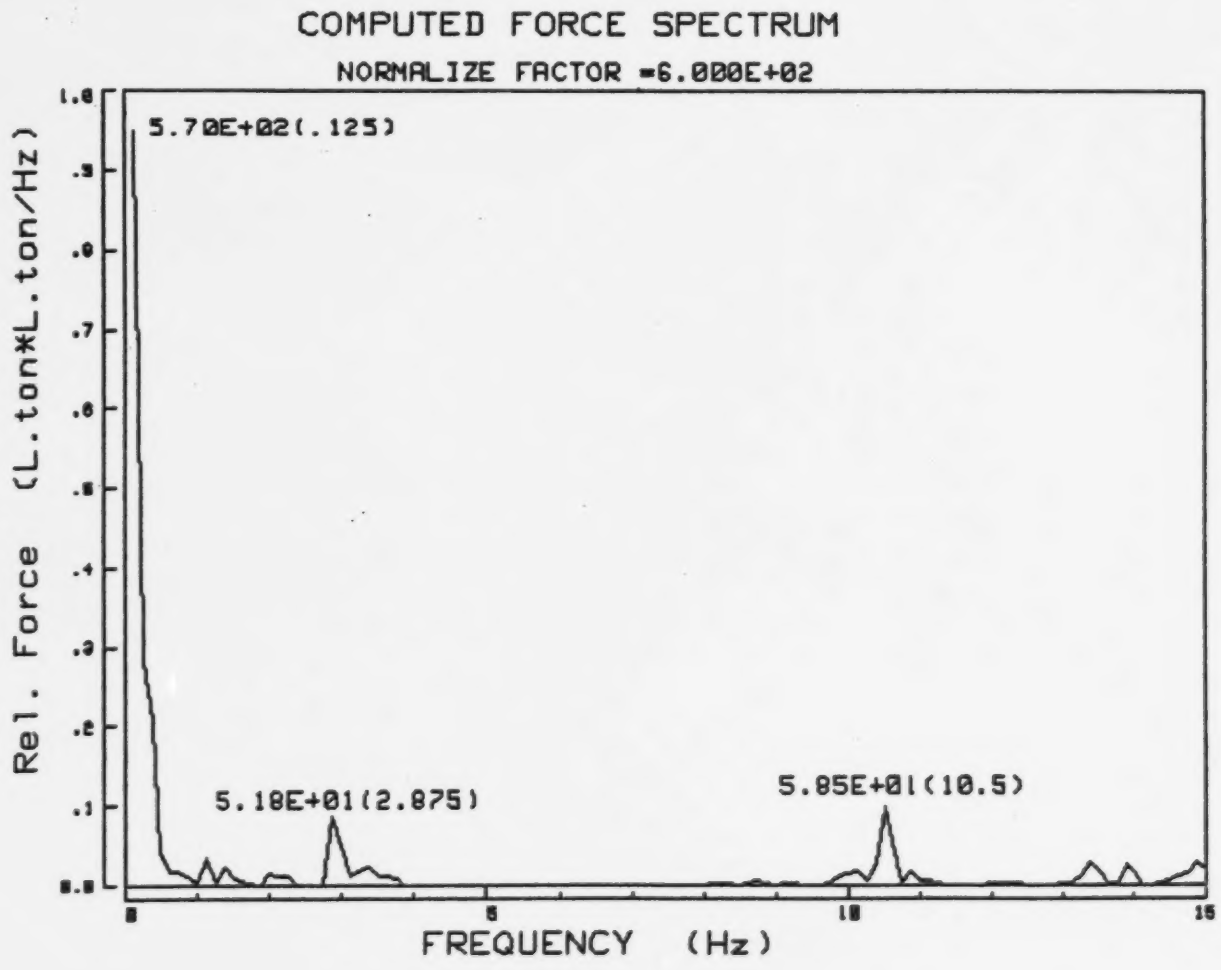


FIGURE 7.5j

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :USCGC POLAR SEA - F.S. TEST - 4'max L.I. RAMMING DEAD-ON
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:08)
Sensor  : ACC. 7Z                        Cal.Factor:1.2345('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F97Z0
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 3.169563E+03(L.ton*L.ton)
  Root Mean Square= 5.629887E+01(L.ton)
```

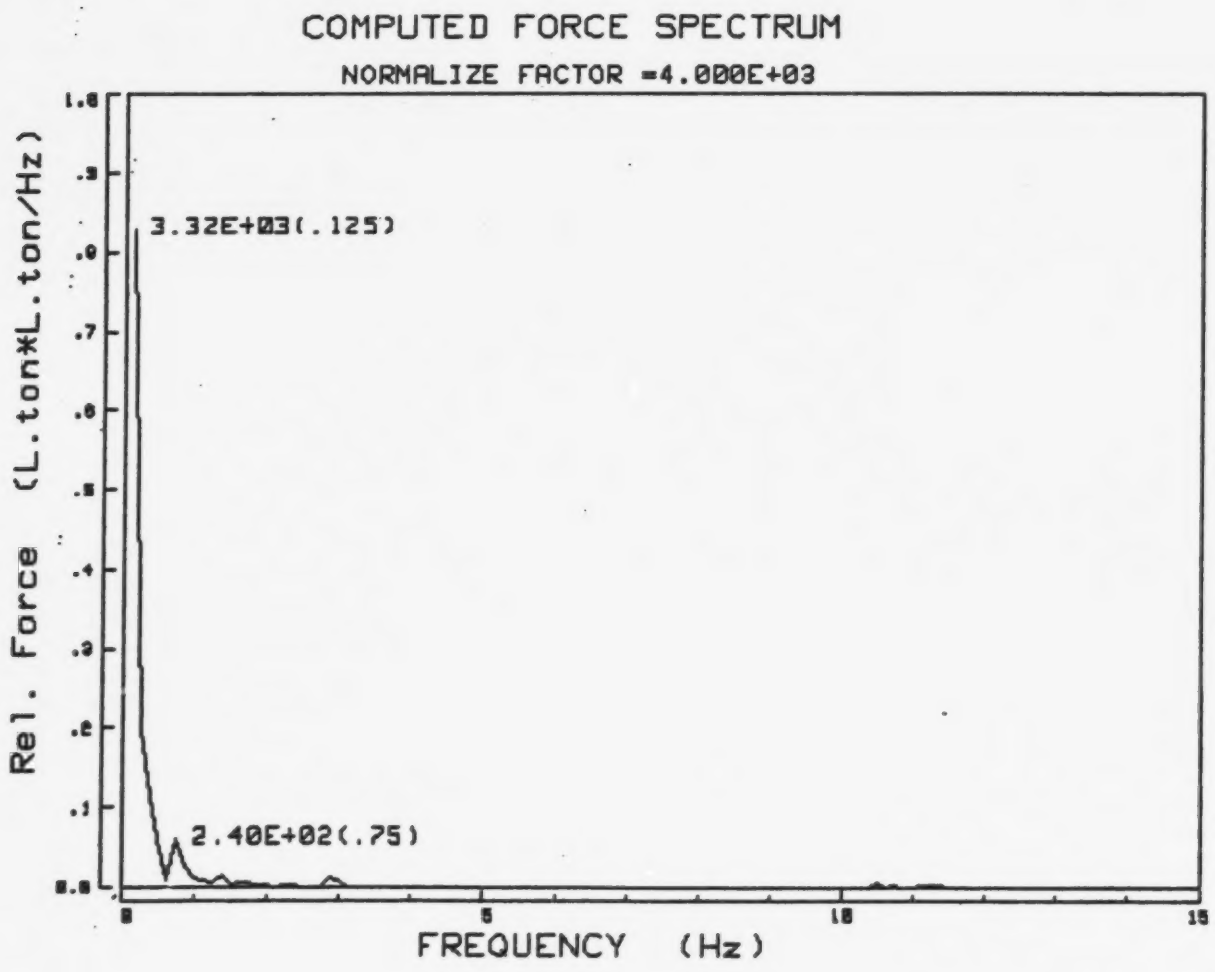


FIGURE 7.6a

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. OBL.RAM. AT 9 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:20)
Sensor  : ACC. 1Y                        Cal.Factor:1.1940('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F91Y1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 20
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.027712E+04(L.ton*L.ton)
  Root Mean Square= 1.013761E+02(L.ton)
```

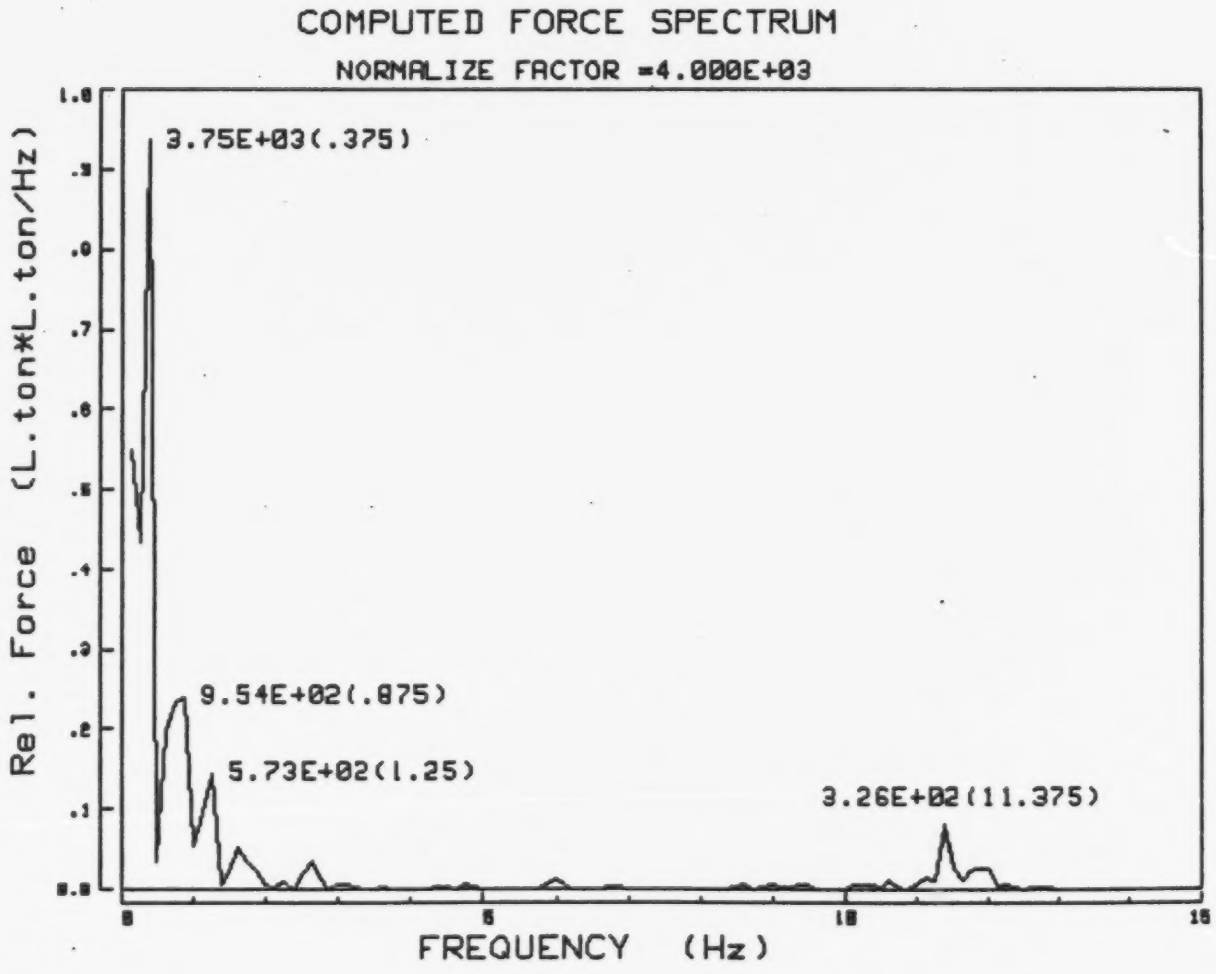


FIGURE 7.6b

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. OBL.RAM. AT 9 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:20)
Sensor  : ACC. 2Y                        Cal.Factor:1.2739('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F92Y1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)
-------------------------------------------------------------------------------

  Mean      Square= 1.639108E+04(L.ton*L.ton)
  Root Mean Square= 1.280277E+02(L.ton)
-------------------------------------------------------------------------------
```

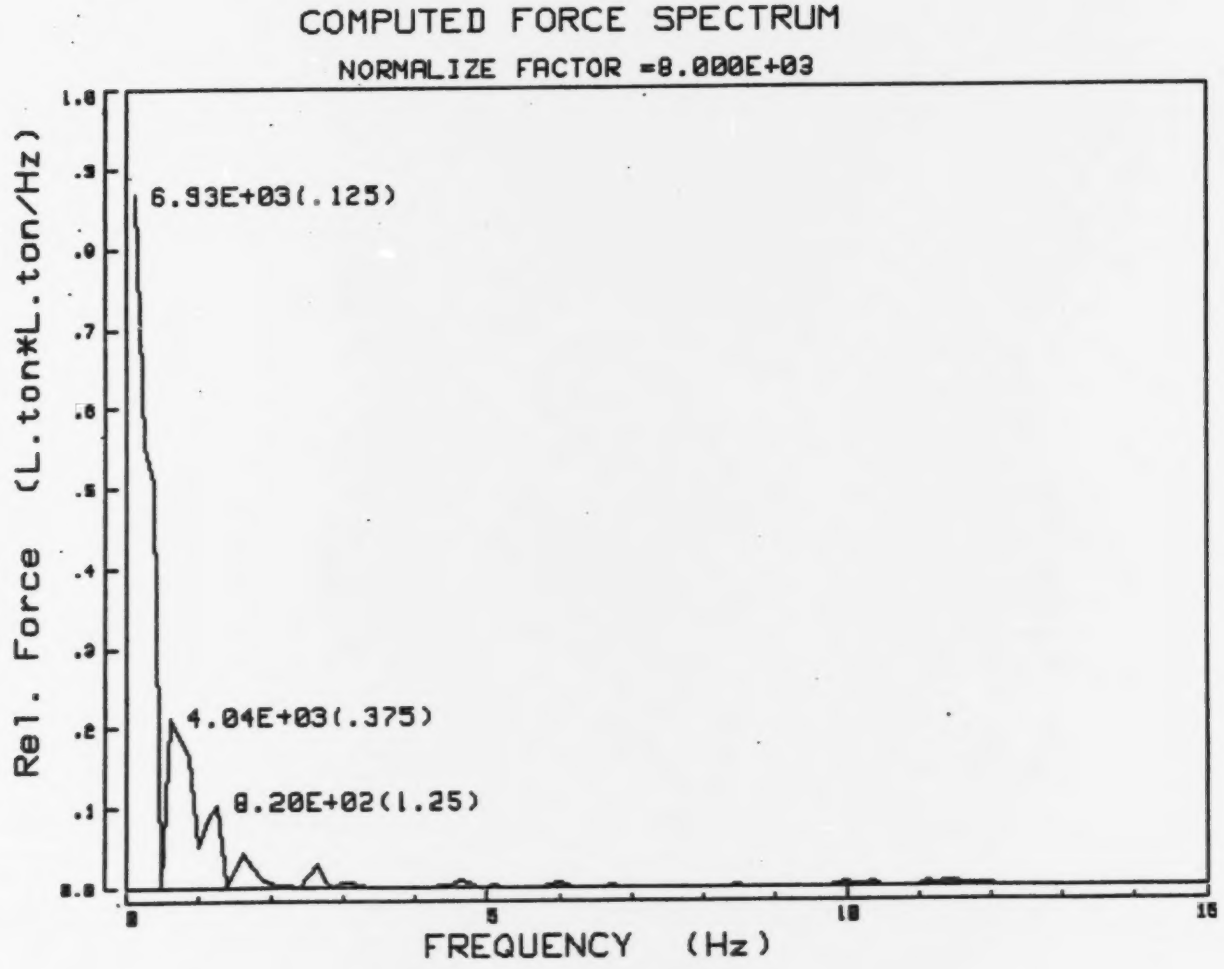


FIGURE 7.6c

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. OBL.RAM. AT 9 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:20)
Sensor  : ACC. 3Y                        Cal.Factor:1.2195('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F93Y1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 16.14
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.135515E+04(L.ton*L.ton)
  Root Mean Square= 1.065605E+02(L.ton)
```

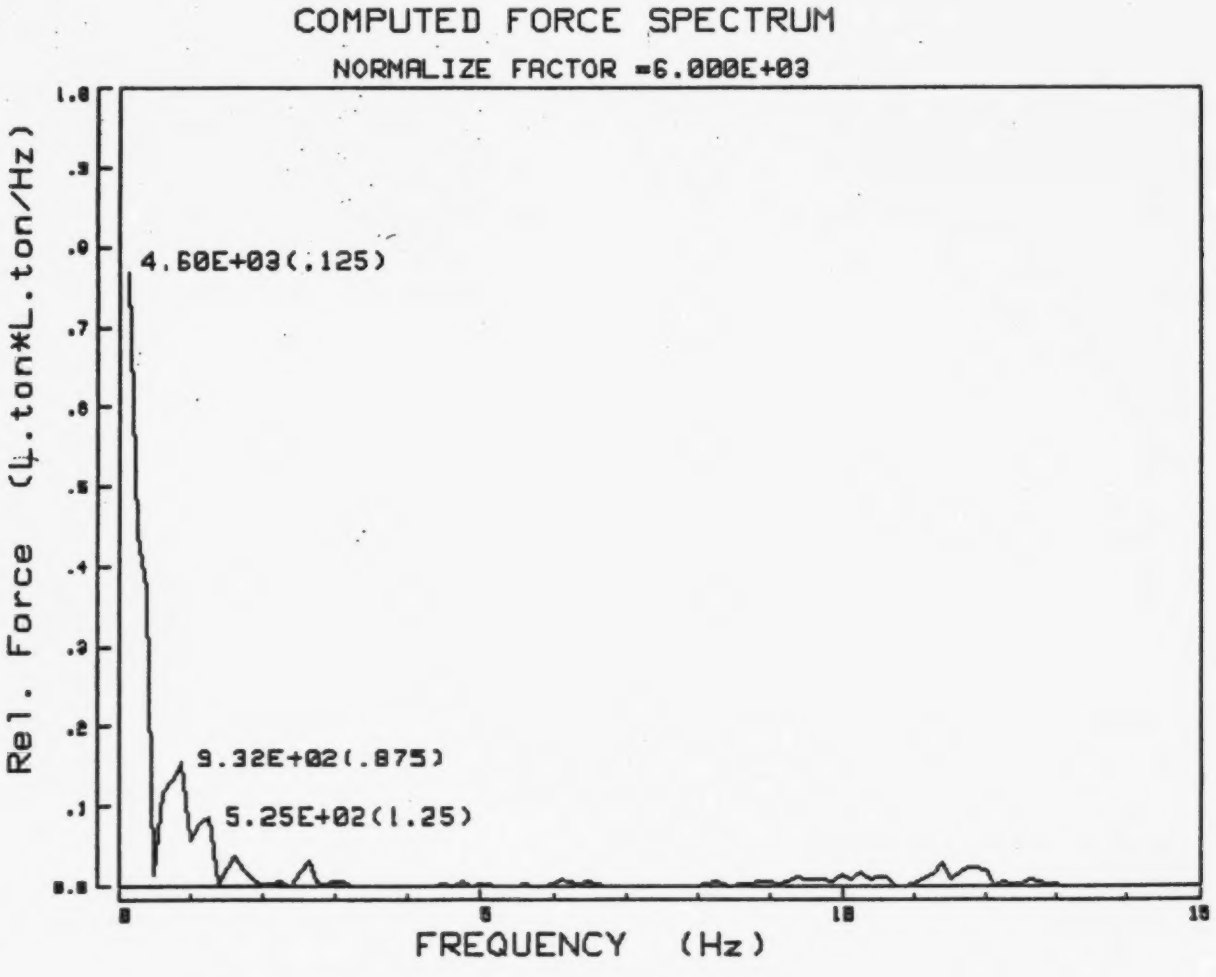


FIGURE 7.6d

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. OBL.RAM. AT 9 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:20)
Sensor  : ACC. 5Y                        Cal.Factor:1.2270('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F95Y1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.203035E+04(L.ton*L.ton)
  Root Mean Square= 1.096829E+02(L.ton)
```

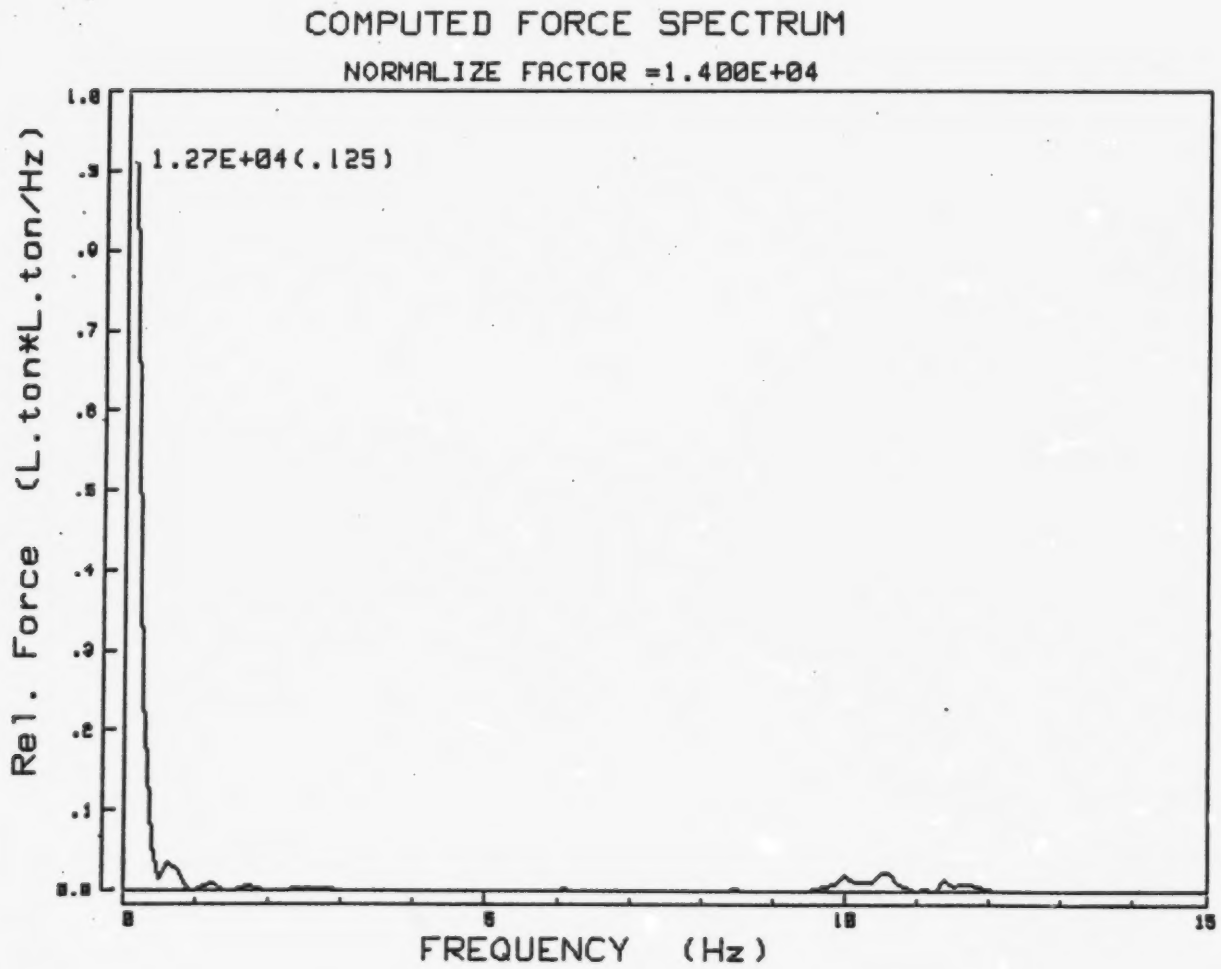


FIGURE 7.6e

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

Subject :POLAR SEA -F.S. TEST -4' max L.I. OBL.RAM. AT 9 Kt
Vessel : USCGC POLAR SEA Test Time:FEB 9 1981 (06:20)
Sensor : ACC. 6Y Cal.Factor:1.2422('g/v)
FreqRange: 50 (Hz) Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending File Name: F96Y1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)

Mean Square= 5.960461E+03(L.ton*L.ton)
Root Mean Square= 7.720403E+01(L.ton)

COMPUTED FORCE SPECTRUM

NORMALIZE FACTOR =8.000E+03

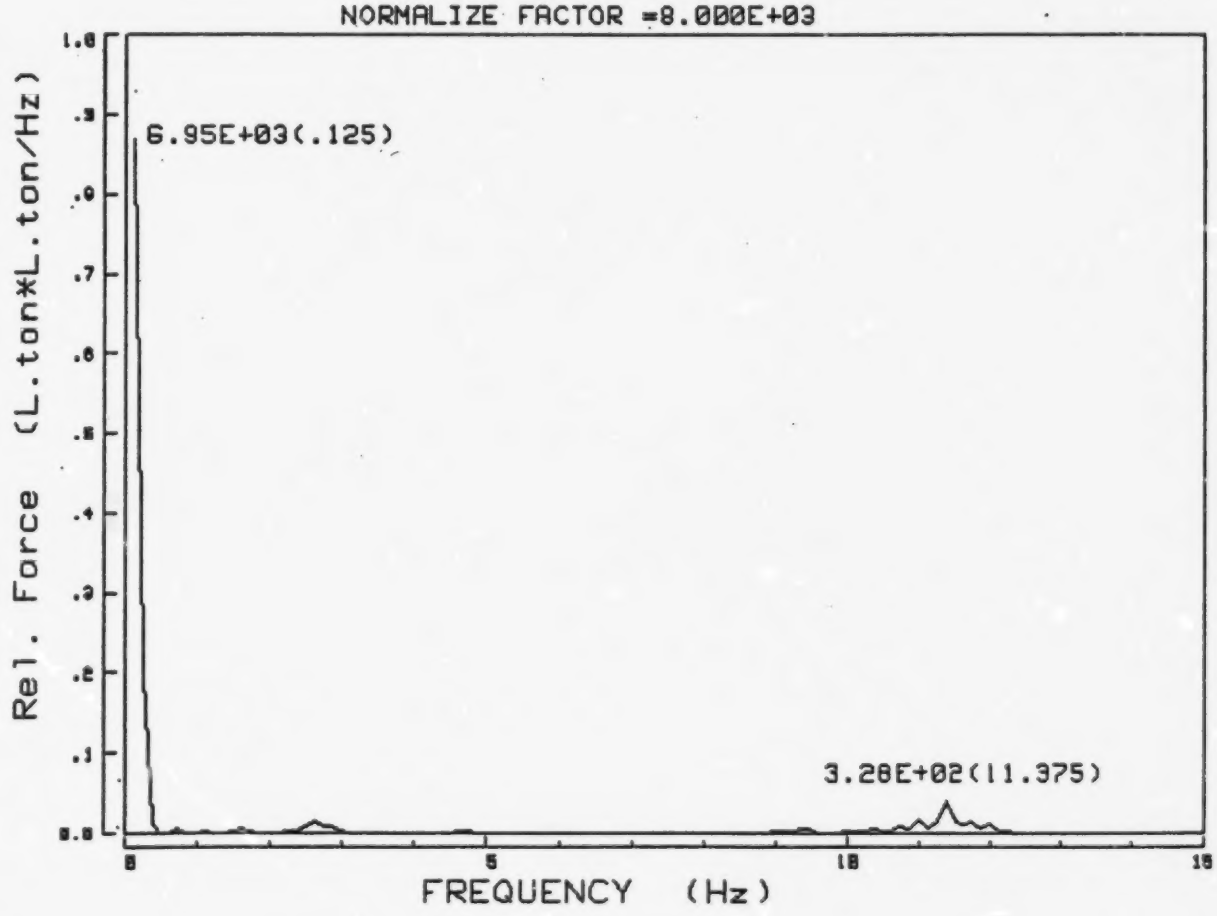


FIGURE 7.6f

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. OBL.RAM. AT 9 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:20)
Sensor  : ACC. 7Y                        Cal.Factor:1.2270('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F97Y1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.576989E+04(L.ton*L.ton)
  Root Mean Square= 1.255782E+02(L.ton)
```

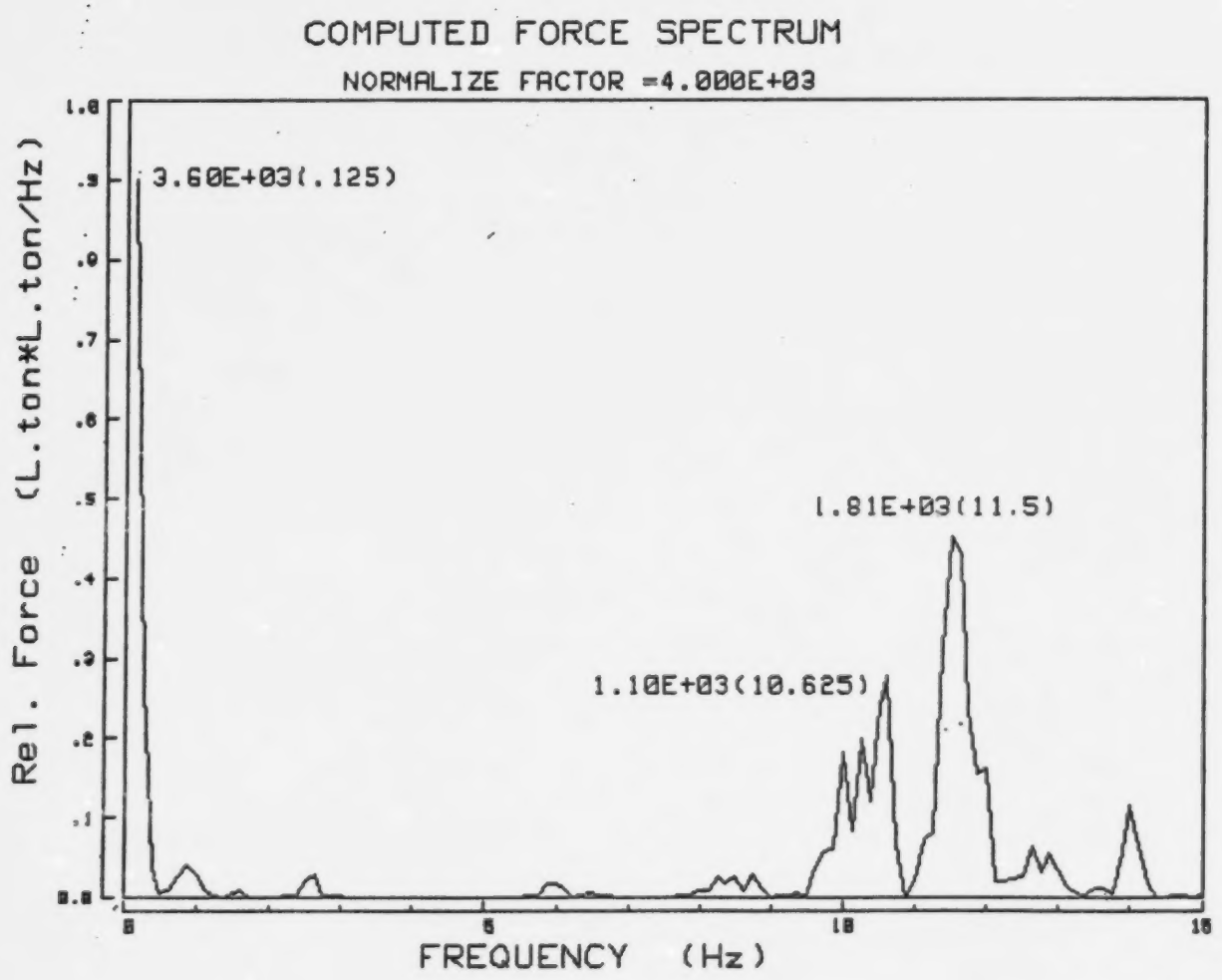


FIGURE 7.6g

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

Subject :POLAR SEA -F.S. TEST -4' max L.I. OBL.RAM. AT 9 Kt
Vessel : USCGC POLAR SEA Test Time:FEB 9 1981 (06:20)
Sensor : ACC. 1Z Cal.Factor:1.2500('g/v)
FreqRange: 50 (Hz) Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending File Name: F91Z1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 20
* Cut-off frequency for force calculation is 15 (Hz)

Mean Square= 9.027900E+03(L.ton*L.ton)
Root Mean Square= 9.501526E+01(L.ton)

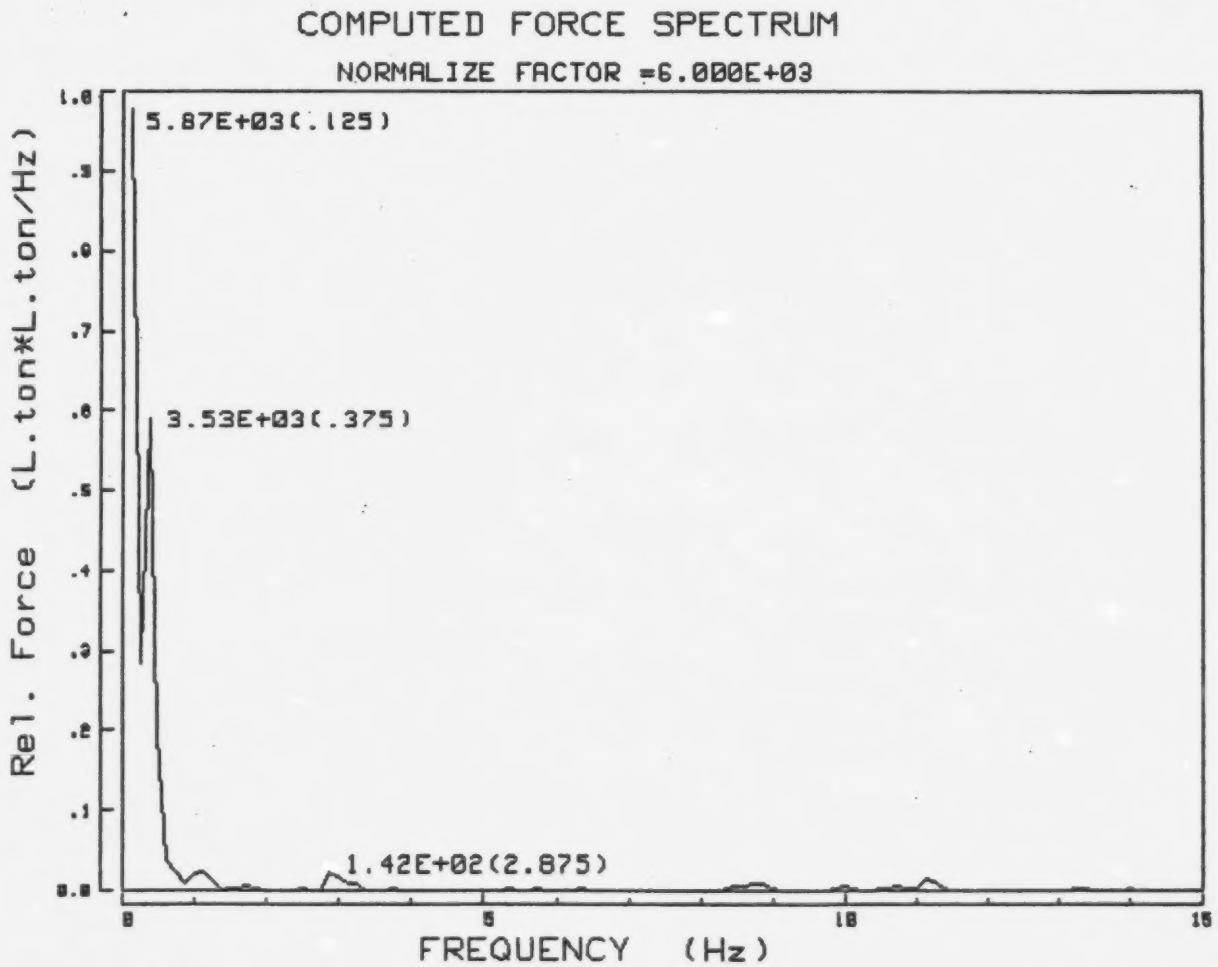


FIGURE 7.6h

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. OBL.RAM. AT 9 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:20)
Sensor  : ACC. 2Z                        Cal.Factor:1.2500('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F92Z1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 4.209250E+03(L.ton*L.ton)
  Root Mean Square= 6.487873E+01(L.ton)
```

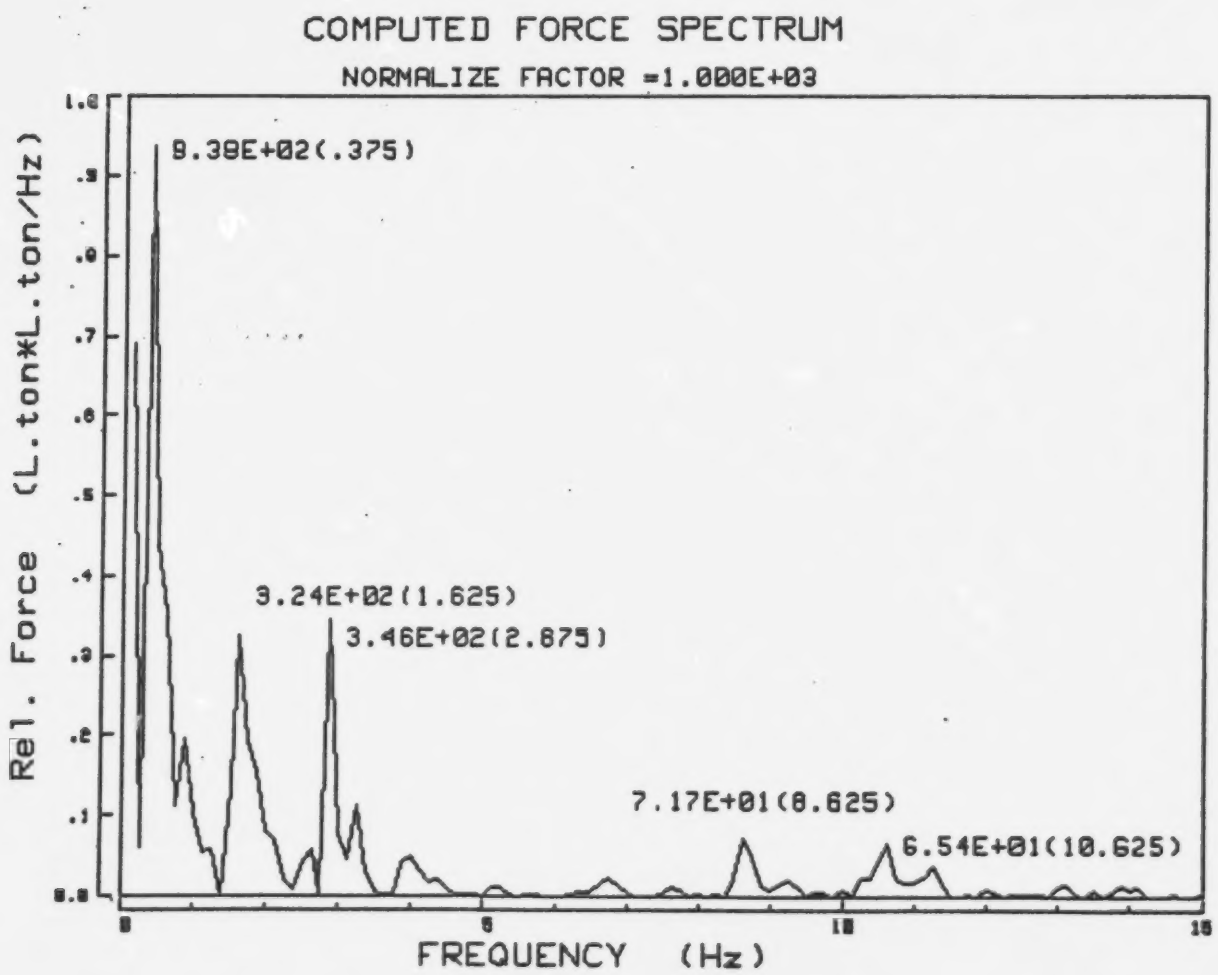


FIGURE 7.61

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. OBL.RAM. AT 9 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:20)
Sensor  : ACC. 5Z                        Cal.Factor:1.2422('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F95Z1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 6.670432E+03(L.ton*L.ton)
  Root Mean Square= 8.167271E+01(L.ton)
```

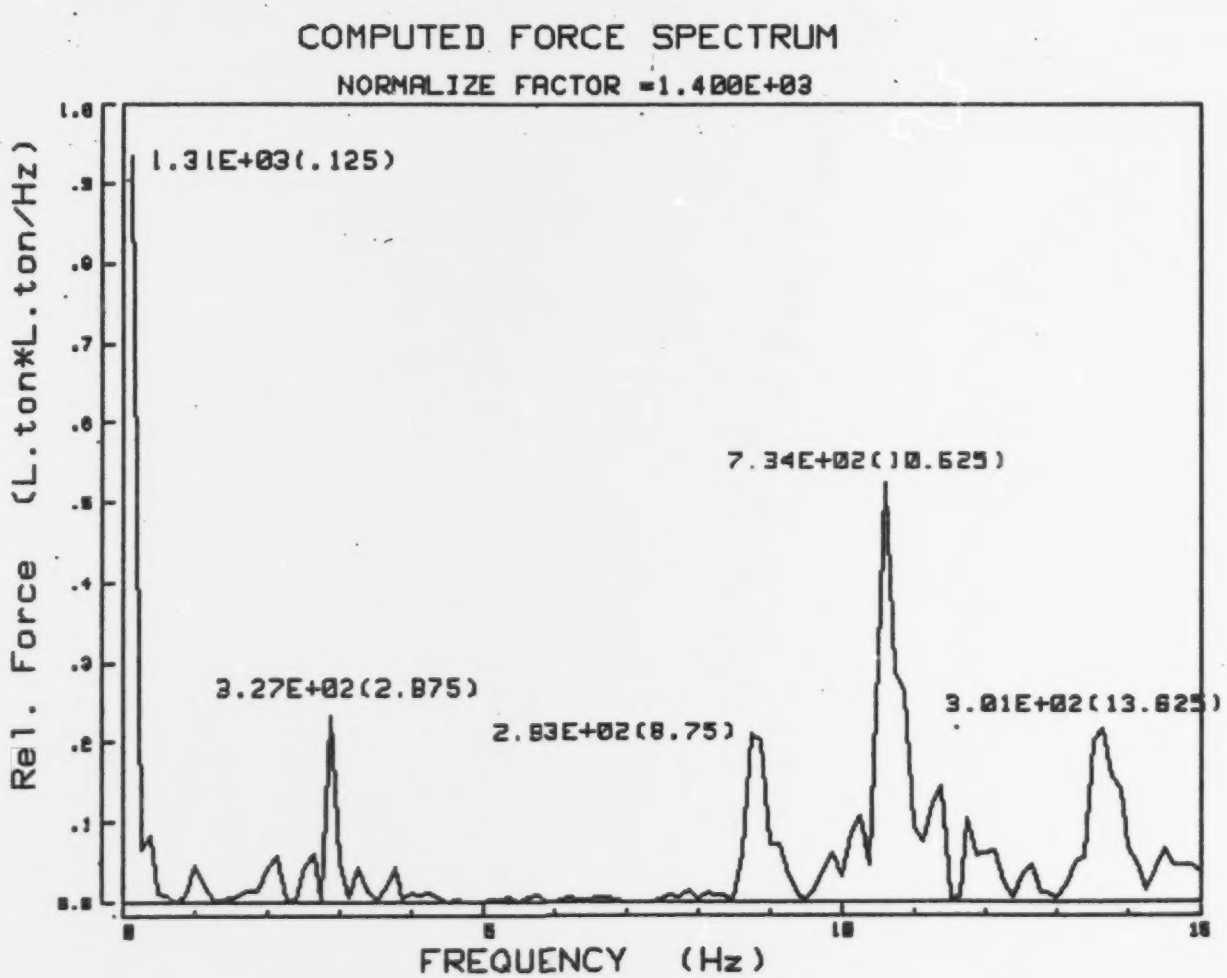


FIGURE 7.6j

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. OBL.RAM. AT 9 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:20)
Sensor  : ACC. 7Z                        Cal.Factor:1.2345('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F97Z1
* Location of applied conc. load is at section # 18.5
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 8.269237E+03(L.ton*L.ton)
  Root Mean Square= 9.093534E+01(L.ton)
```

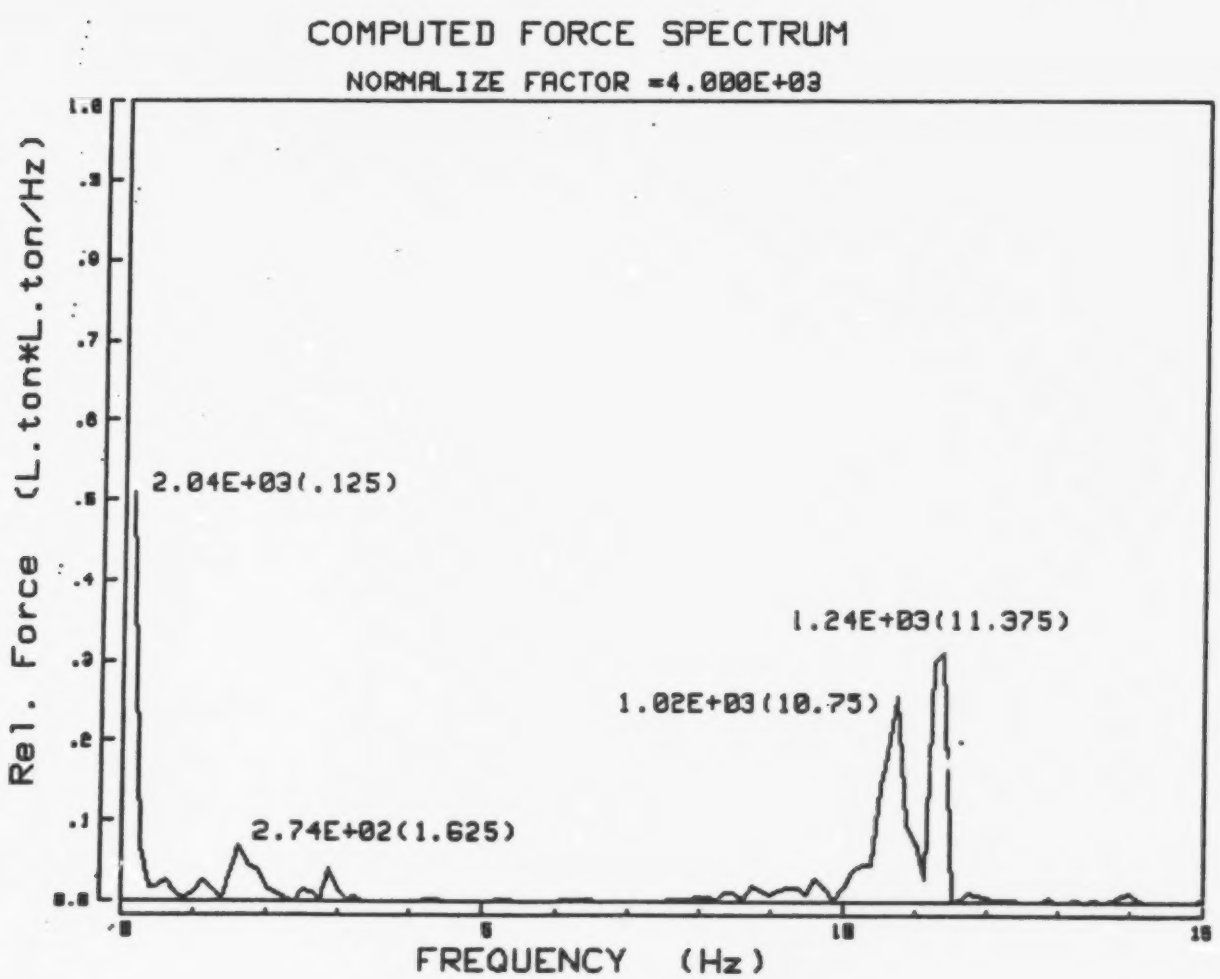


FIGURE 7.7a

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. RAM OBLIQUE (S) AT 7 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:28)
Sensor  : ACC. 1Y                        Cal.Factor:1.1940('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib..Mode: Horizontal Bending            File Name: F91Y2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 20
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 3.219808E+04(L.ton*L.ton)
  Root Mean Square= 1.794382E+02(L.ton)
```

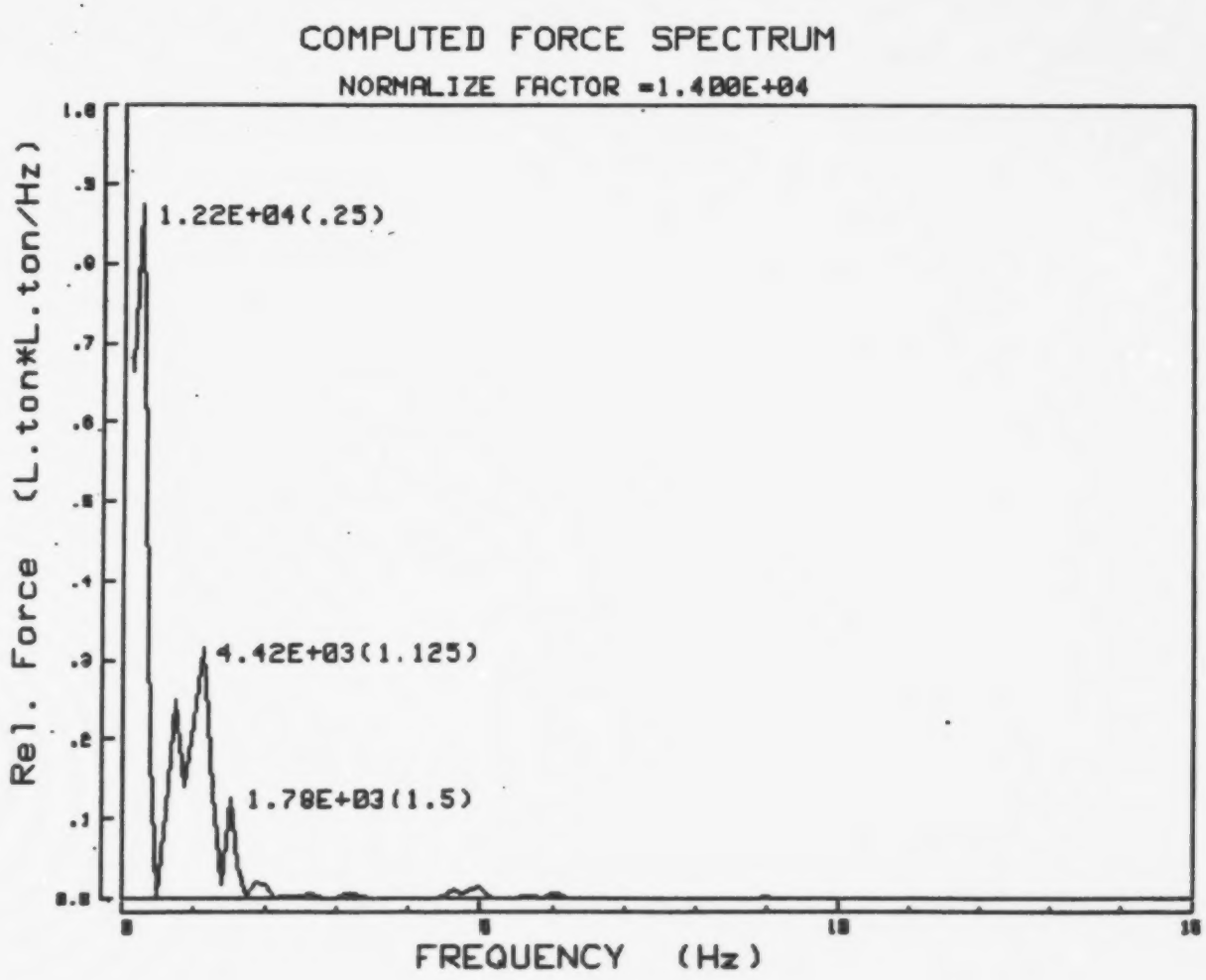


FIGURE 7.7b

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

Subject :POLAR SEA -F.S. TEST -4' max L.I. RAM OBLIQUE (S) AT 7 Kt
Vessel : USCGC POLAR SEA Test Time:FEB 9 1981 (06:28)
Sensor : ACC. 2Y Cal.Factor:1.2739('g/v)
FreqRange: 50 (Hz) Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending File Name: F92Y2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)

Mean Square= 5.227106E+04(L.ton*L.ton)
Root Mean Square= 2.286287E+02(L.ton)

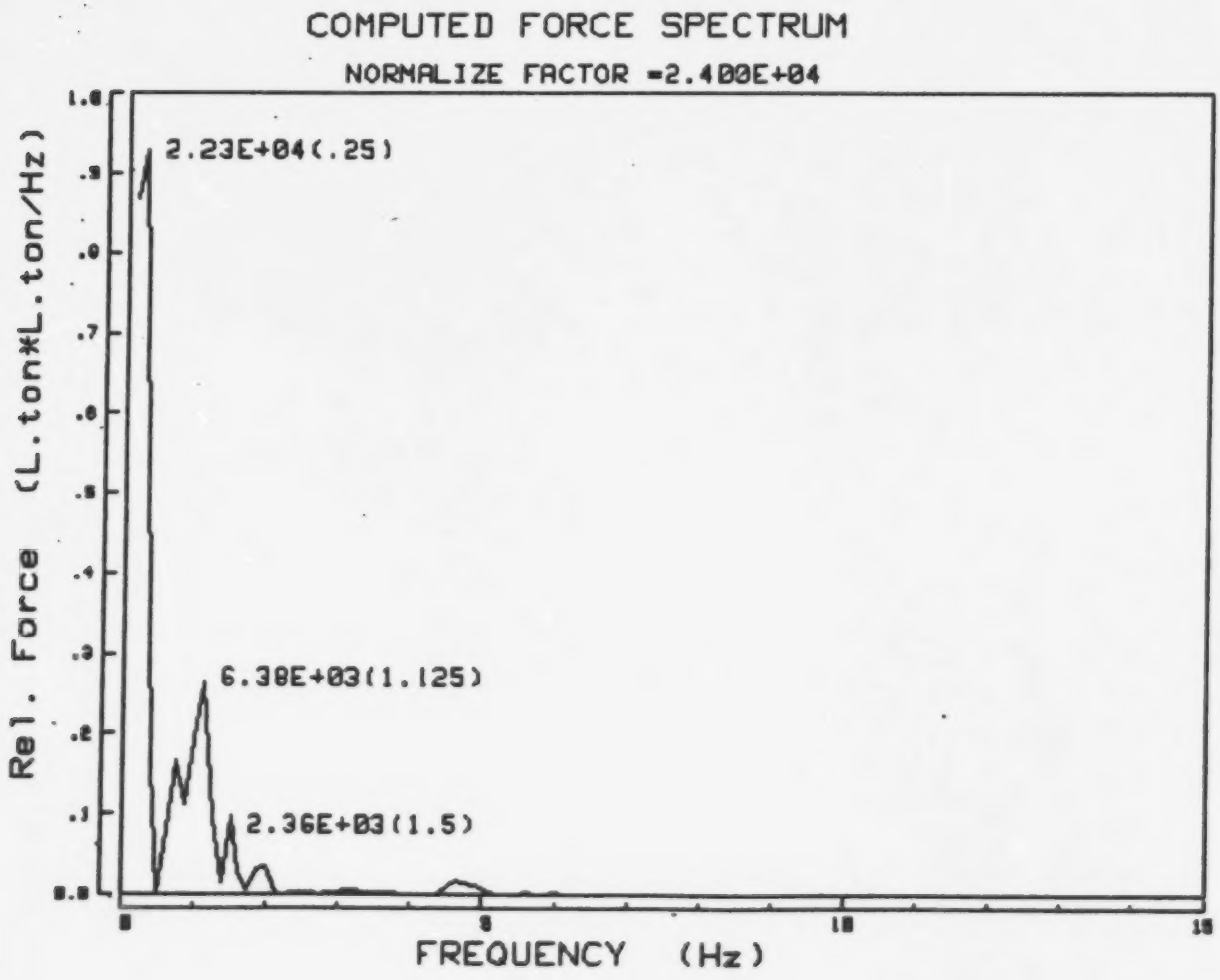


FIGURE 7.7c

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. RAM OBLIQUE (S) AT 7 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:28)
Sensor  : ACC. 3Y                        Cal.Factor:1.2195('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib..Mode: Horizontal Bending            File Name: F83Y2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 16.14
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 2.778083E+04(L.ton*L.ton)
  Root Mean Square= 1.666758E+02(L.ton)
```

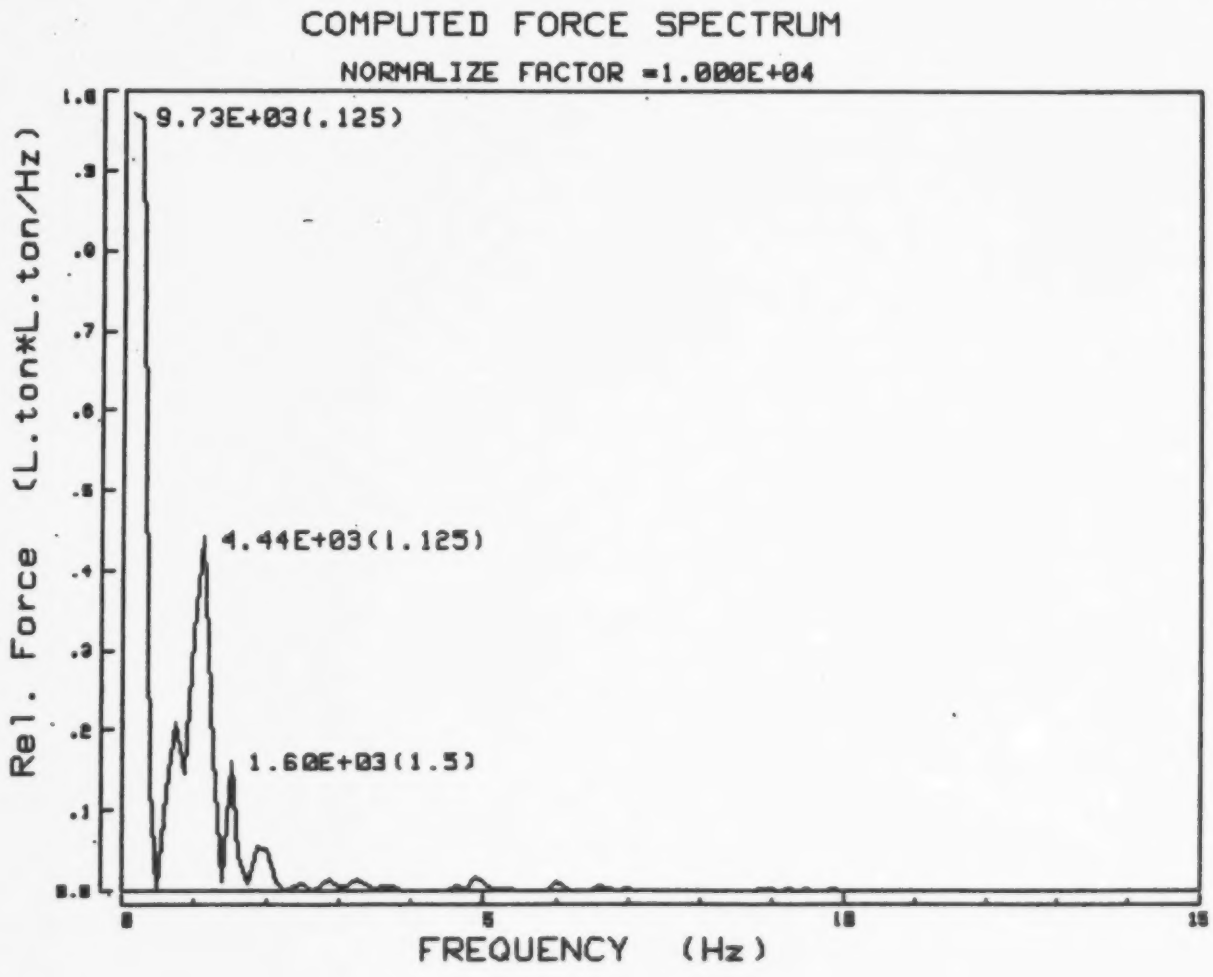


FIGURE 7.7d

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. RAM OBLIQUE (S) AT 7 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:28)
Sensor  : ACC. 5Y                        Cal.Factor:1.2270('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F95Y2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 3.220425E+04(L.ton*L.ton)
  Root Mean Square= 1.794554E+02(L.ton)
```

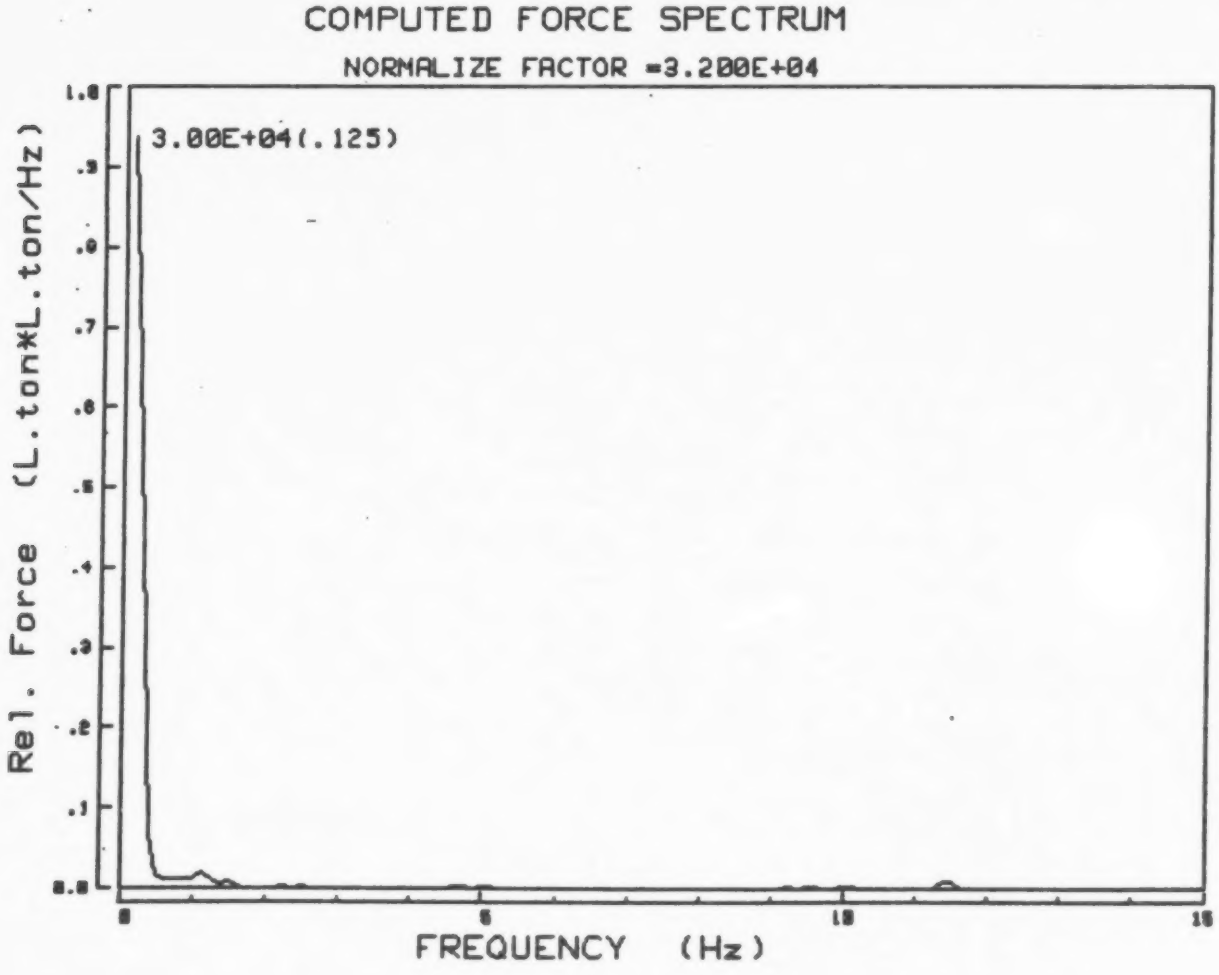


FIGURE 7.7e

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. RAM OBLIQUE (S) AT 7 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:28)
Sensor  : ACC. 6Y                        Cal.Factor:1.2422('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F96Y2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.488447E+04(L.ton*L.ton)
  Root Mean Square= 1.220019E+02(L.ton)
```

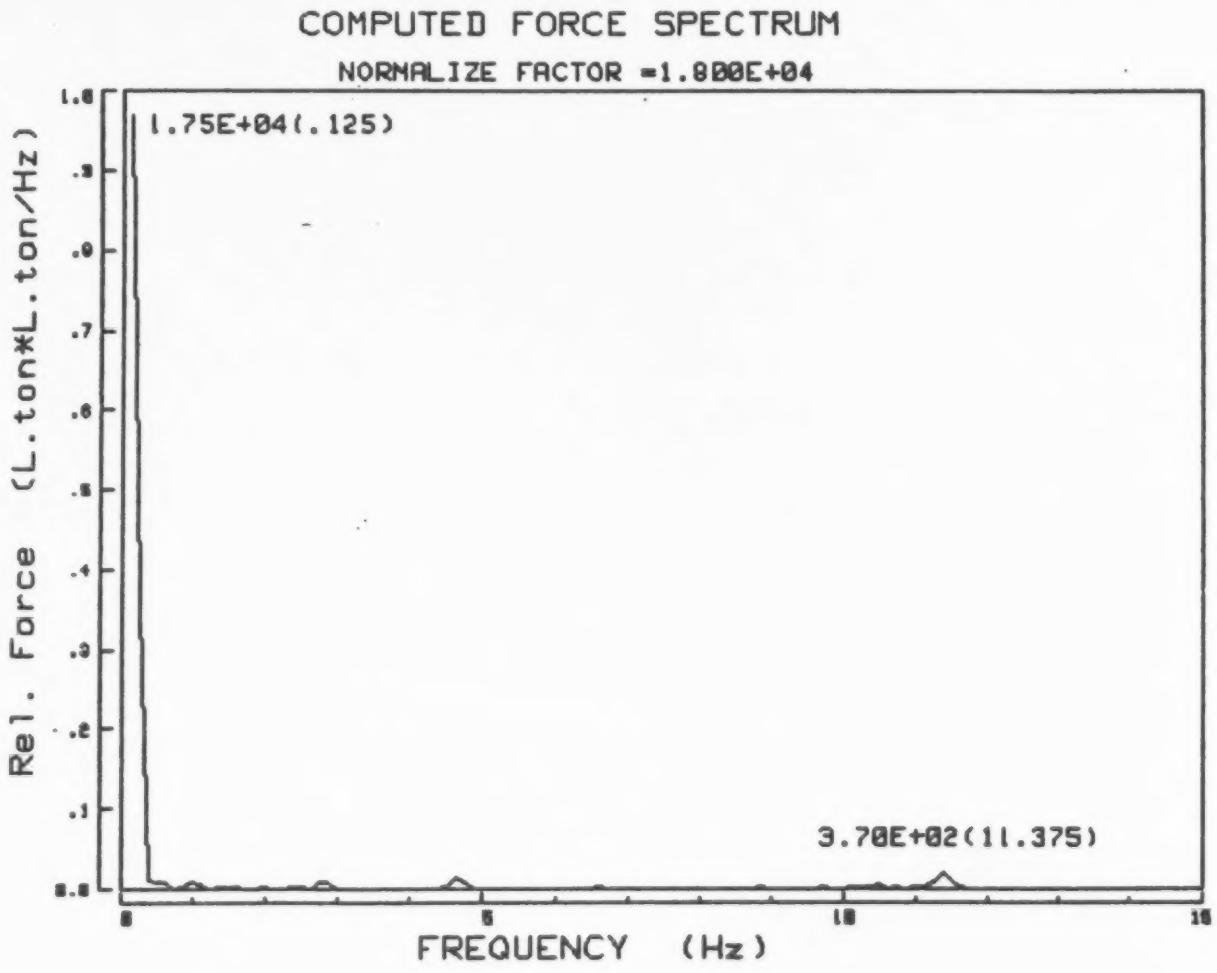


FIGURE 7.7f

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. RAM OBLIQUE (S) AT 7 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:28)
Sensor  : ACC. 7Y                        Cal.Factor:1.2270('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F97Y2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.492379E+04(L.ton*L.ton)
  Root Mean Square= 1.221630E+02(L.ton)
```

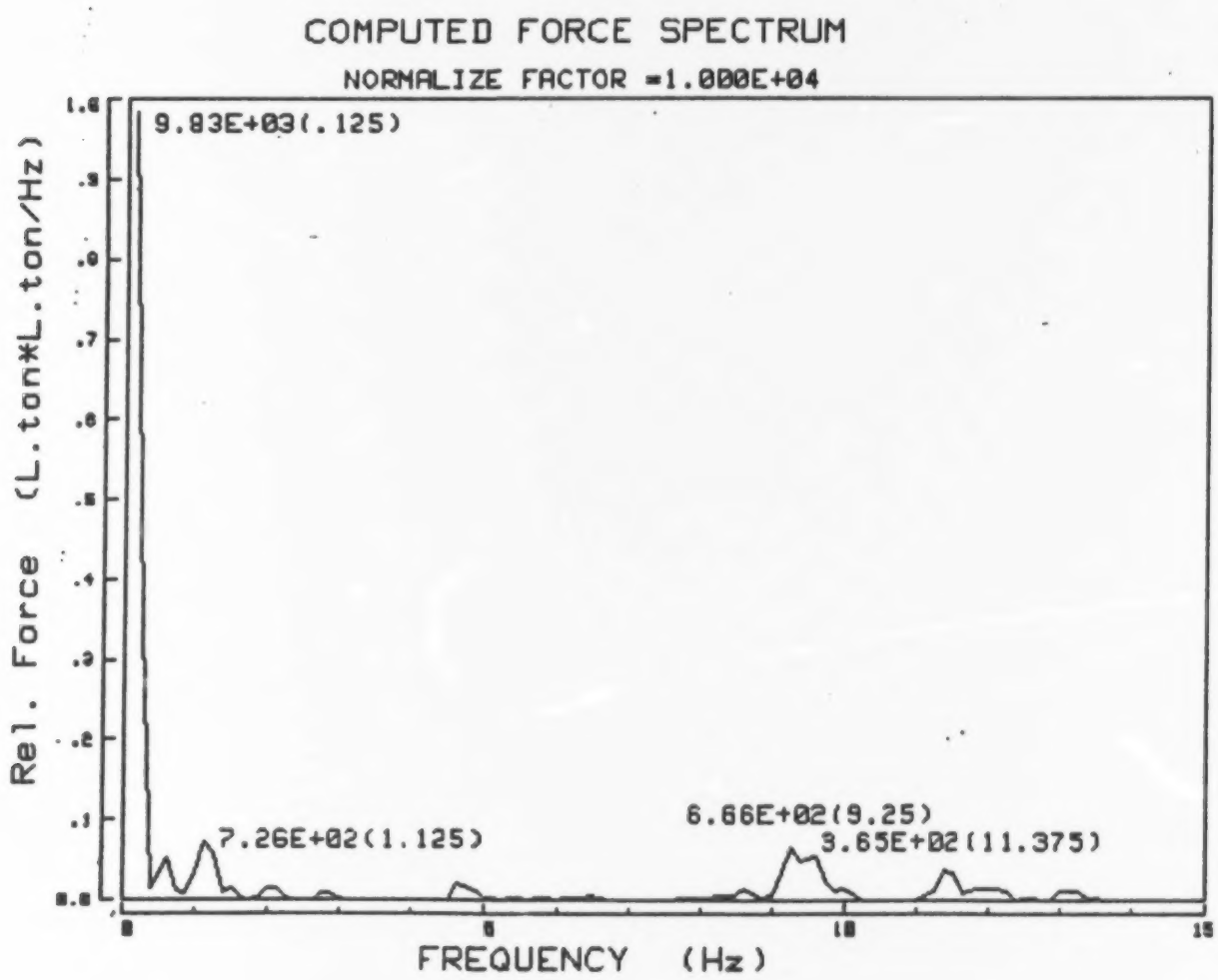


FIGURE 7.7g

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. RAM OBLIQUE (S) AT 7 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:28)
Sensor  : ACC. 1Z                        Cal.Factor:1.2500('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F91Z2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 20
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.643403E+04(L.ton*L.ton)
  Root Mean Square= 1.281953E+02(L.ton)
```

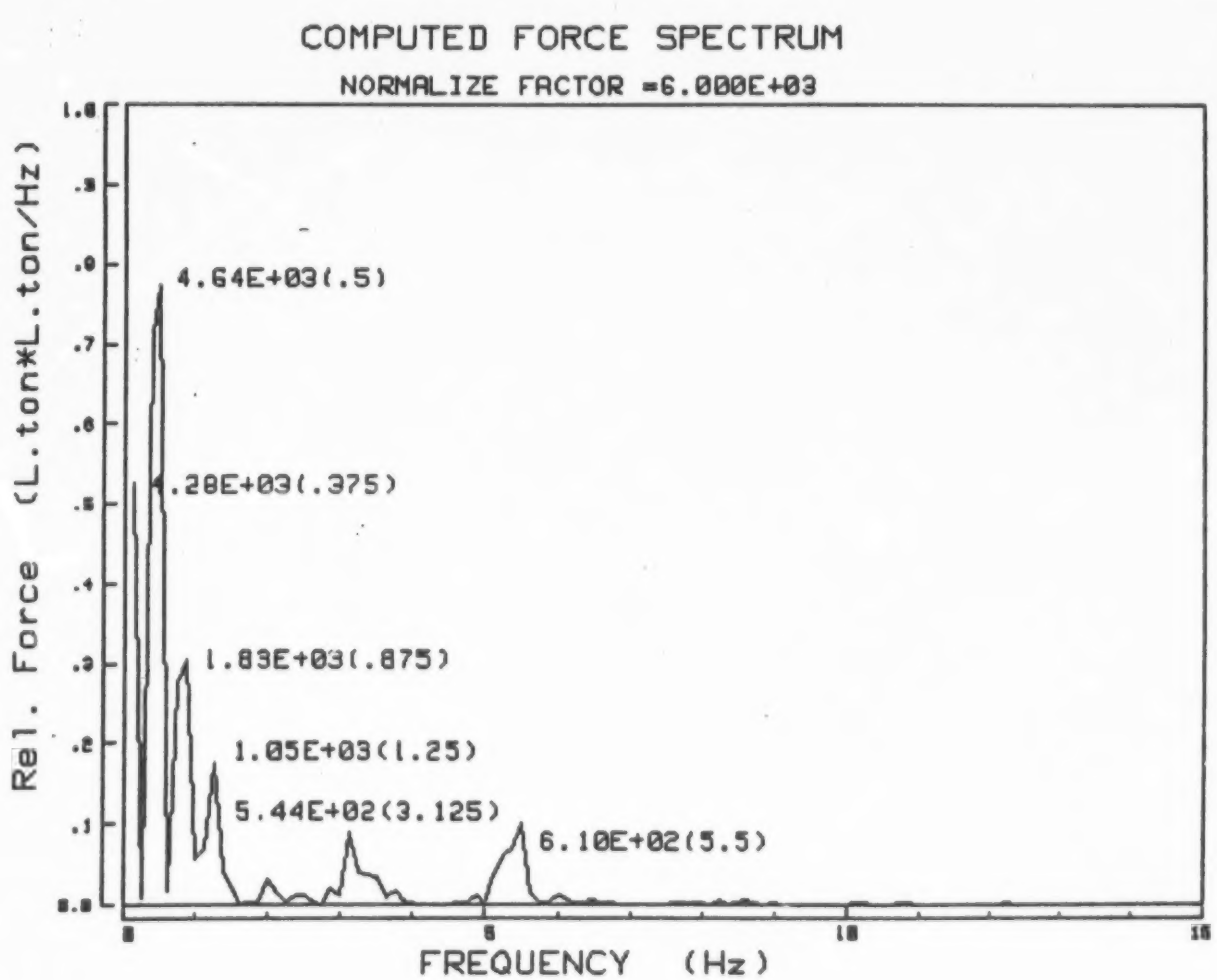


FIGURE 7.7h

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. RAM OBLIQUE (S) AT 7 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:28)
Sensor  : ACC. 2Z                        Cal.Factor:1.2500('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F82Z2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 2.135126E+04(L.ton*L.ton)
  Root Mean Square= 1.461207E+02(L.ton)
```

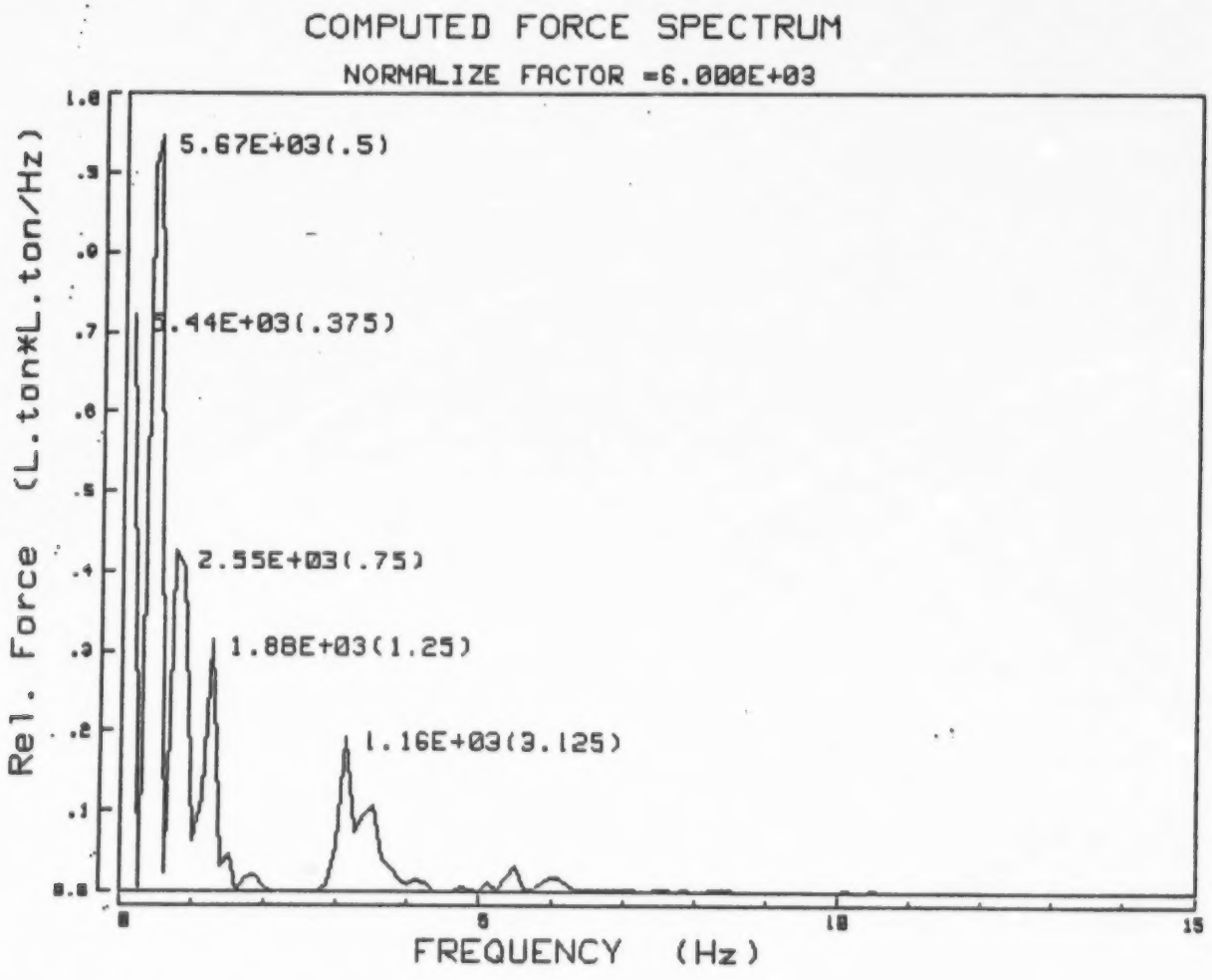


FIGURE 7.7i

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. RAM OBLIQUE (S) AT 7 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:28)
Sensor  : ACC. 5Z                        Cal.Factor:1.2422('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F95Z2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 5.731732E+03(L.ton*L.ton)
  Root Mean Square= 7.570820E+01(L.ton)
```

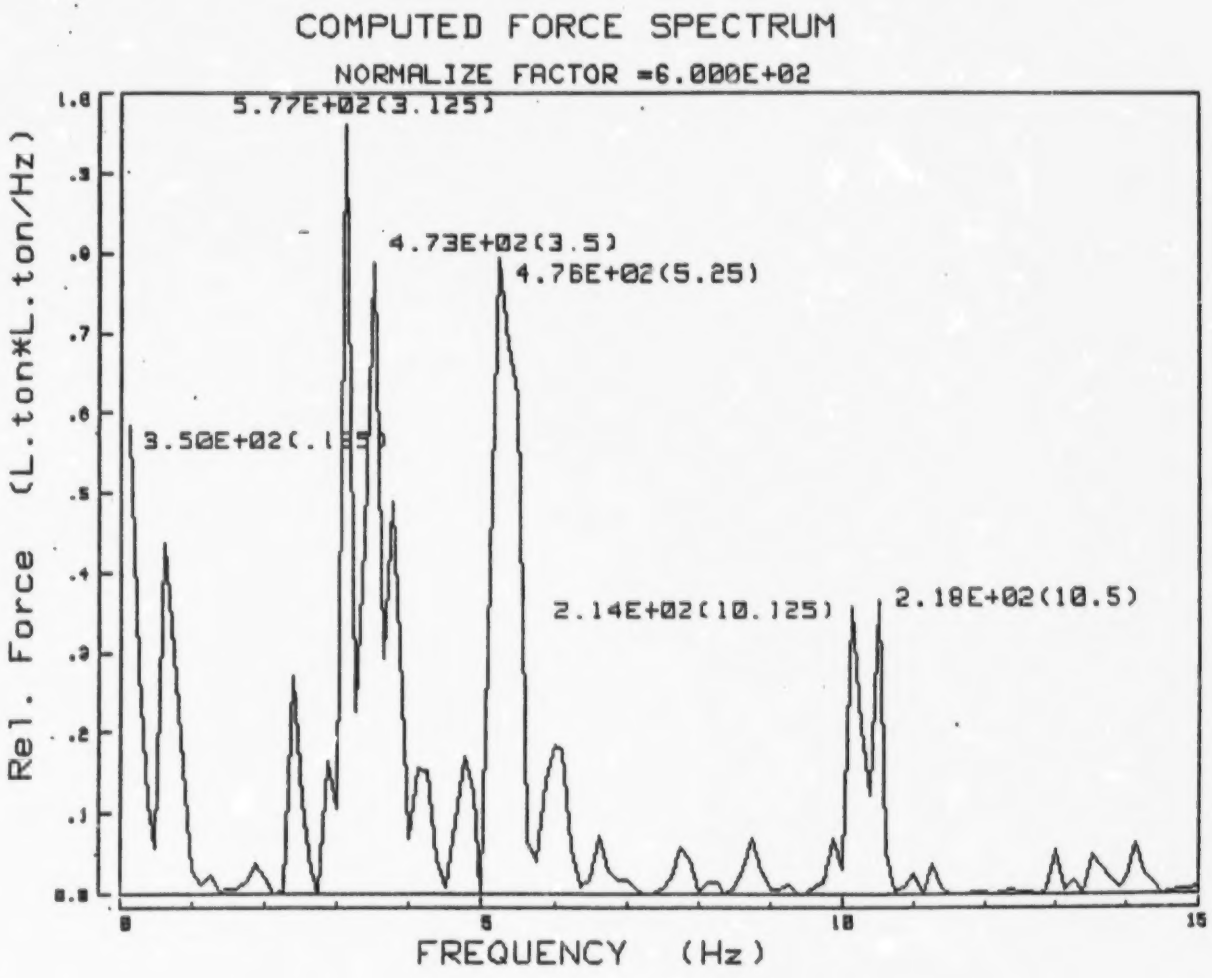


FIGURE 7.7j

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S. TEST -4' max L.I. RAM OBLIQUE (S) AT 7 Kt
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (06:28)
Sensor  : ACC. 7Z                        Cal.Factor:1.2345('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F97Z2
* Location of applied conc. load is at section # 17.4
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 9.016594E+03(L.ton*L.ton)
  Root Mean Square= 9.495575E+01(L.ton)
```

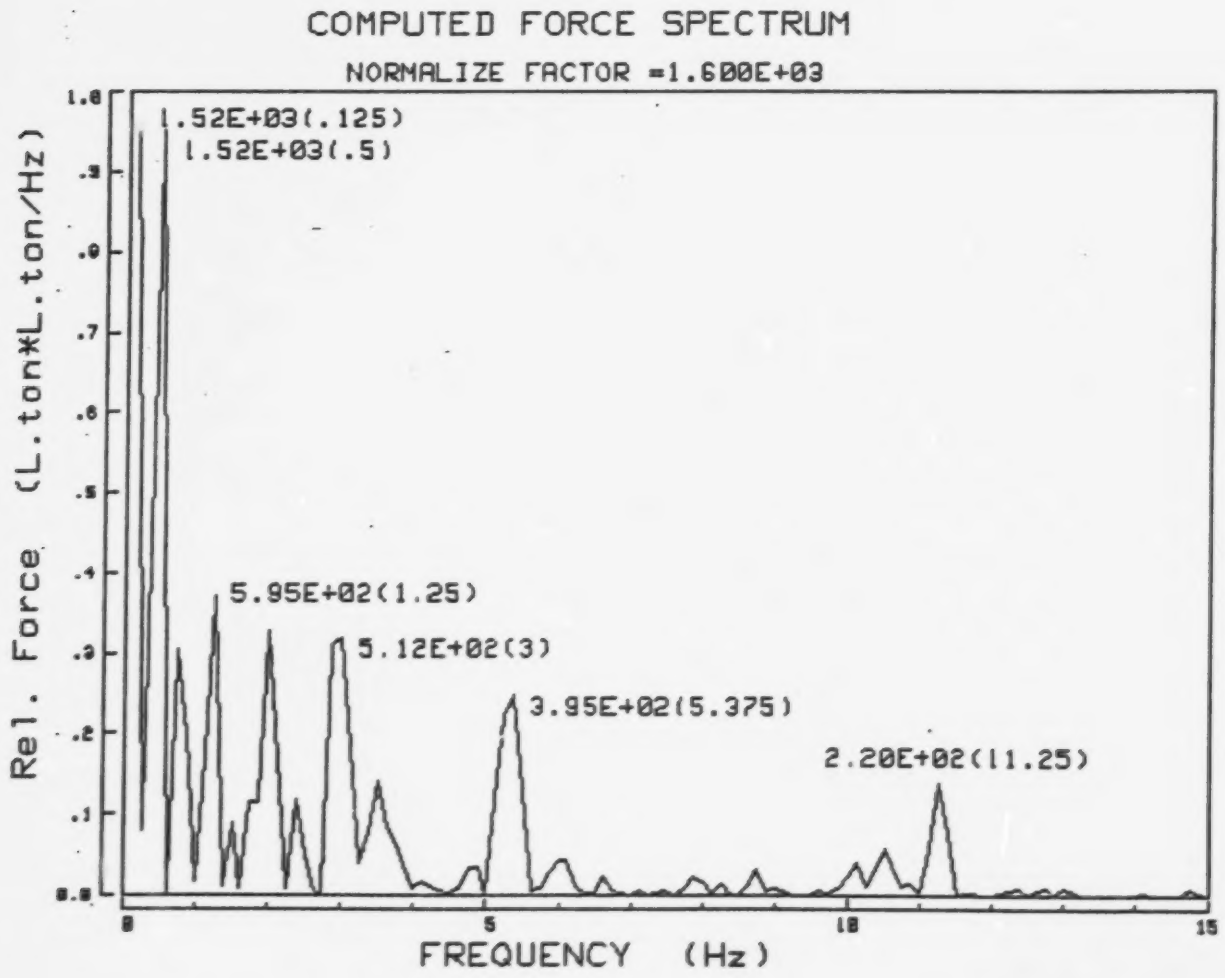


FIGURE 7.8a

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST -Transit Ramming 3'max L.I.
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (13:50)
Sensor  : ACC. 1Y                        Cal.Factor:1.1940('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F91Y4
* Location of applied conc. load is at section # 19.3
* Cut-off frequency for force calculation is 15 (Hz)
```

Mean Square= 1.397446E+04(L.ton*L.ton)
Root Mean Square= 1.182136E+02(L.ton)

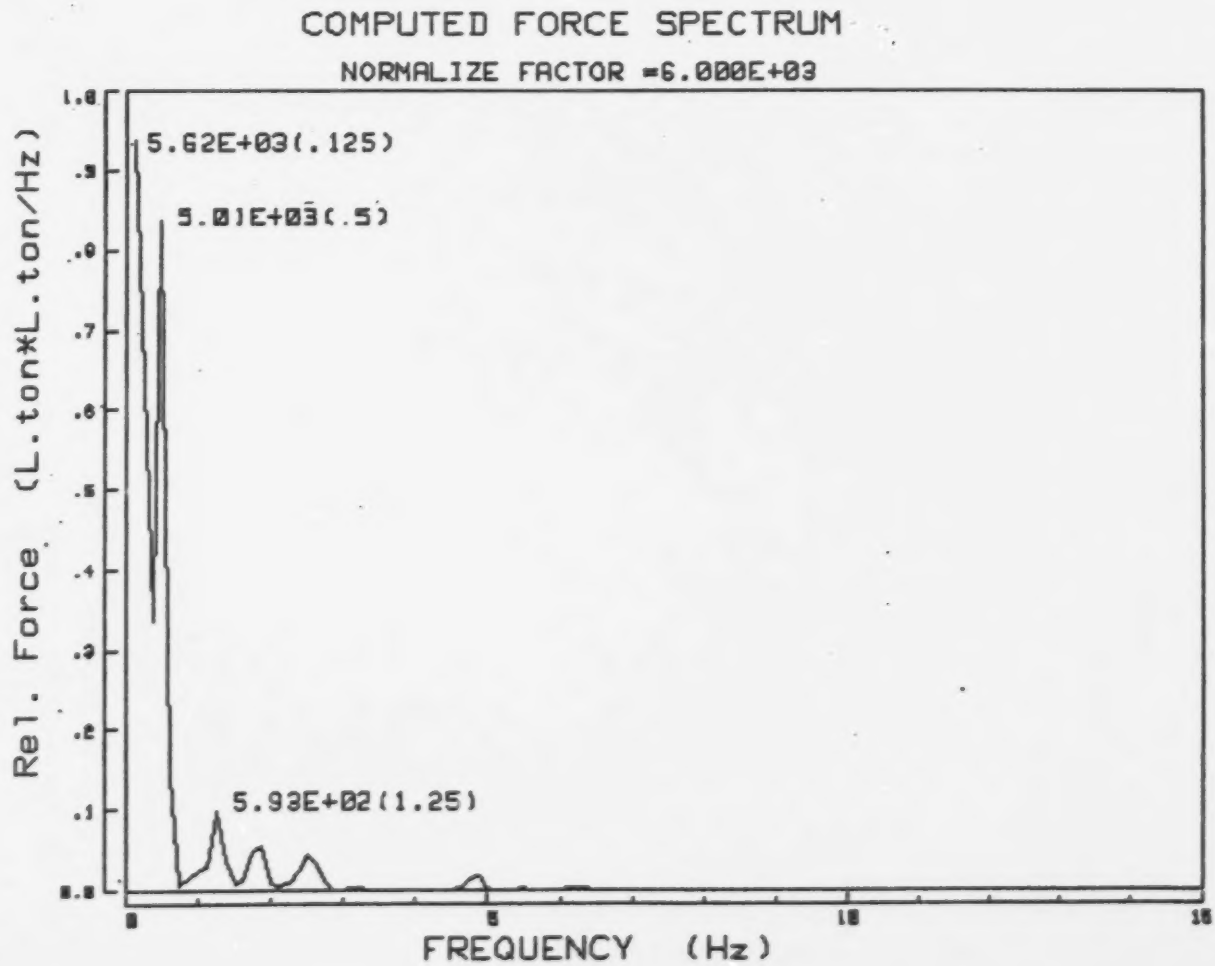


FIGURE 7.8b

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST -Transit Ramming 3'max L.I.
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (13:50)
Sensor  : ACC. 2Y                        Cal.Factor:1.2739('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F92Y4
* Location of applied conc. load is at section # 19.3
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 2.354488E+04(L.ton*L.ton)
  Root Mean Square= 1.534434E+02(L.ton)
```

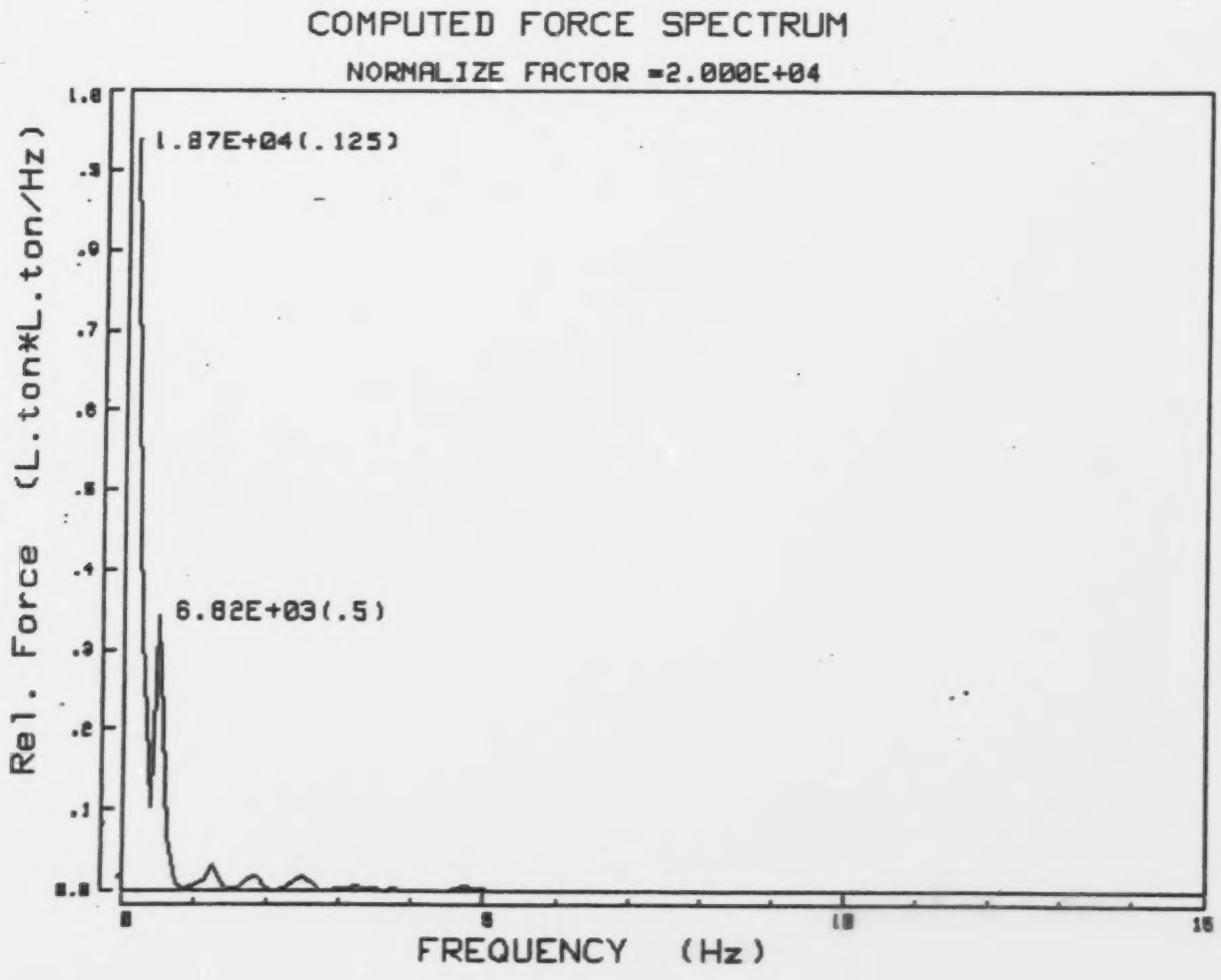


FIGURE 7.8c

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

Subject :POLAR SEA -F.S.TEST -Transit Ramming 3'max L.I.
Vessel : USCGC POLAR SEA Test Time:FEB 9 1981 (13:58)
Sensor : ACC. 3Y Cal.Factor:1.2195('g/v)
FreqRange: 50 (Hz) Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending File Name: F93Y4
* Location of applied conc. load is at section # 19.3
* Location of accelerometer is at section 16.14
* Cut-off frequency for force calculation is 15 (Hz)

Mean Square= 1.202850E+04(L.ton*L.ton)
Root Mean Square= 1.096745E+02(L.ton)

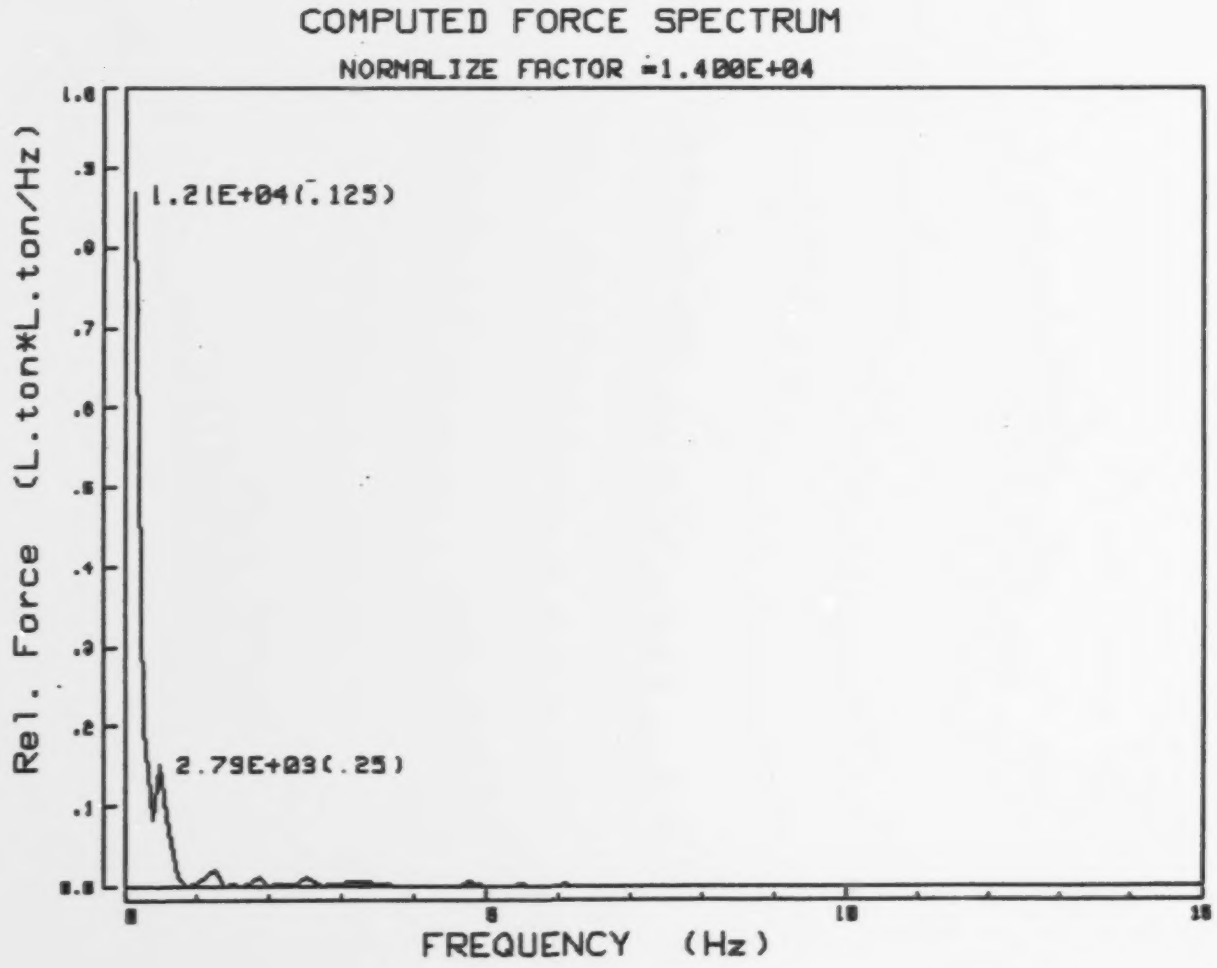


FIGURE 7.8d

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST -Transit Ramming 3'max L.I.
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (13:50)
Sensor  : ACC. 5Y                        Cal.Factor:1.2270('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F95Y4
* Location of applied conc. load is at section # 19.3
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

Mean Square= 2.211088E+04(L.ton*L.ton)
Root Mean Square= 1.486946E+02(L.ton)

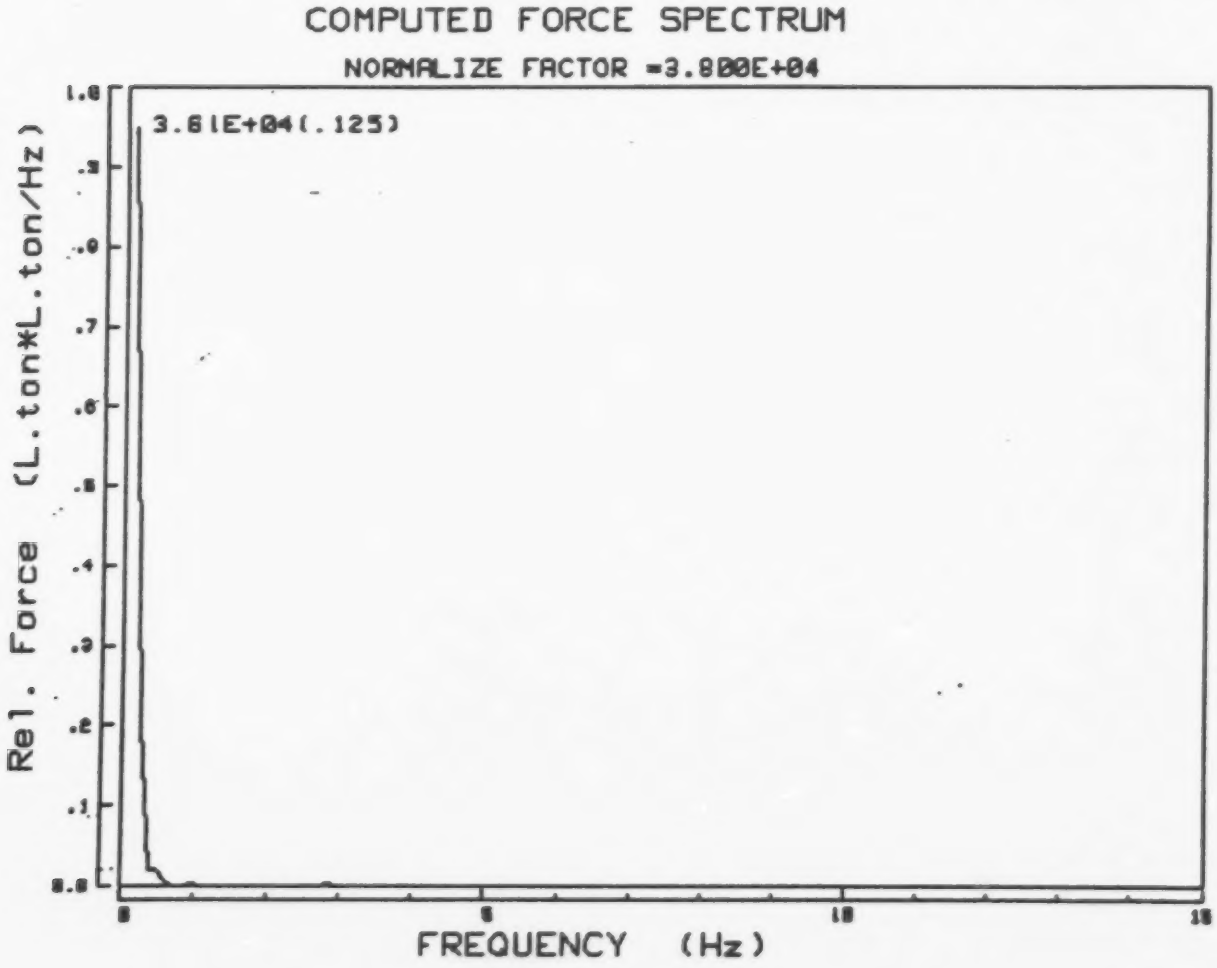


FIGURE 7.8e

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST -Transit Ramming 3'max L.I.
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (13:50)
Sensor  : ACC. 6Y                        Cal.Factor:1.2422('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F96Y4
* Location of applied conc. load is at section @ 19.3
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 9.320019E+03(L.ton*L.ton)
  Root Mean Square= 9.654024E+01(L.ton)
```

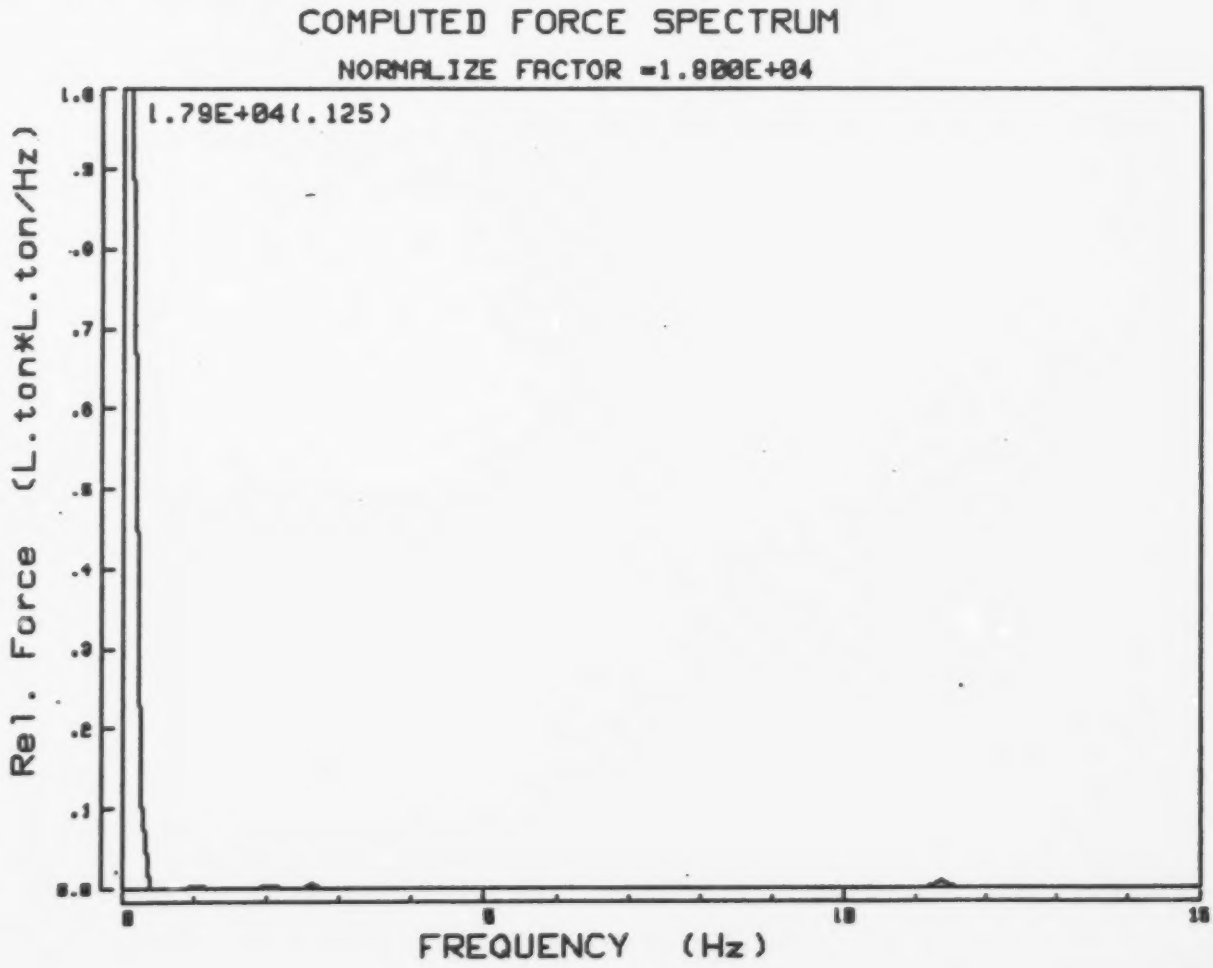


FIGURE 7.8f

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST -Transit Ramming 3'max L.I.
Vessel  : USCGC POLAR SEA                  Test Time:FEB 9 1981 (13:50)
Sensor  : ACC. 7Y                          Cal.Factor:1.2270('g/v)
FreqRange:    50 (Hz)                      Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending              File Name: F97Y4
* Location of applied conc. load is at section # 19.3
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 4.467160E+03(L.ton*L.ton)
  Root Mean Square= 6.683682E+01(L.ton)
```

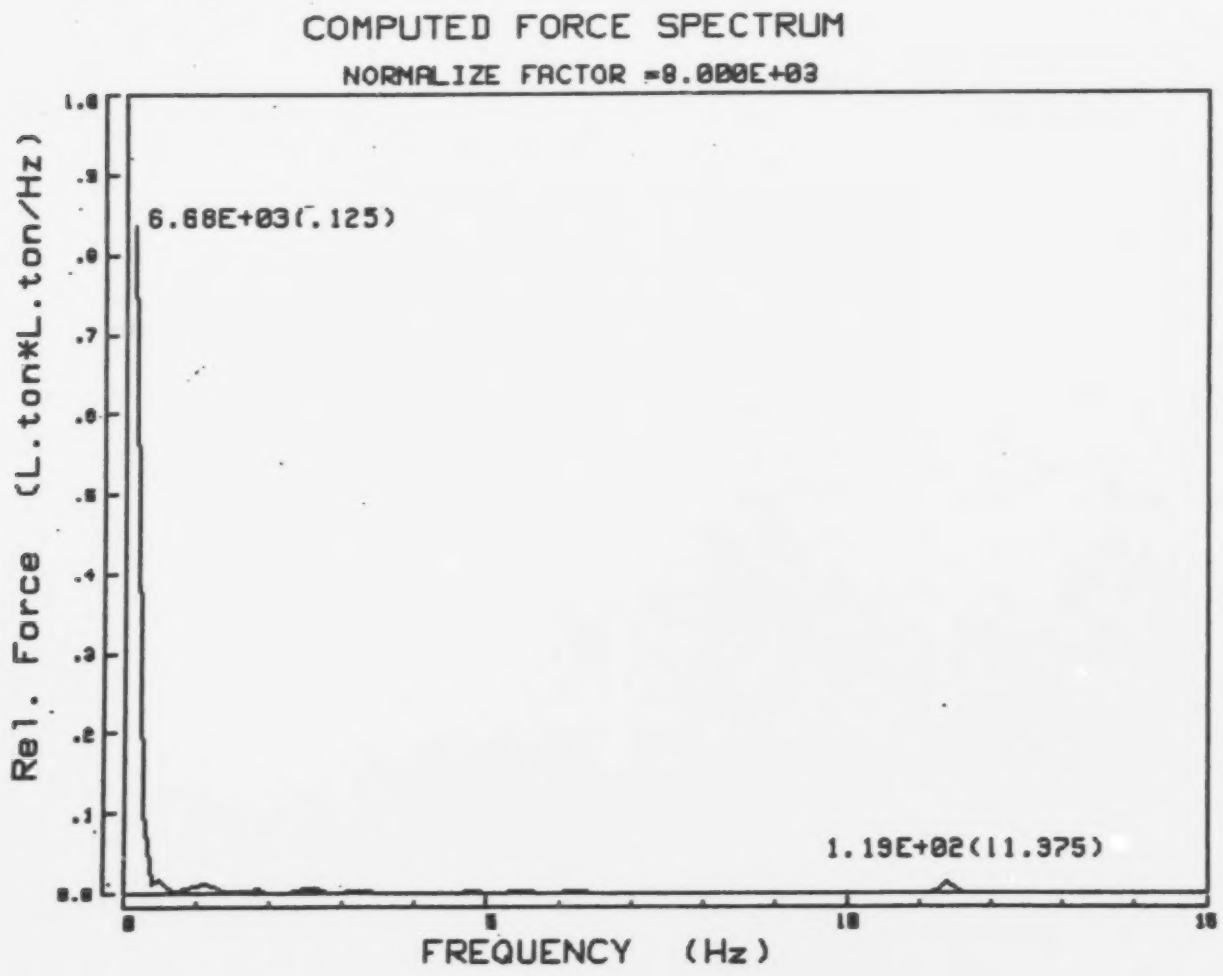


FIGURE 7.8g

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST -Transit Ramming 3'max L.I.
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (13:50)
Sensor  : ACC. 1Z                        Cal.Factor:1.2500('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F91Z4
* Location of applied conc. load is at section # 19.3
* Location of accelerometer is at section 20
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 4.957584E+03(L.ton*L.ton)
  Root Mean Square= 7.041812E+01(L.ton)
```

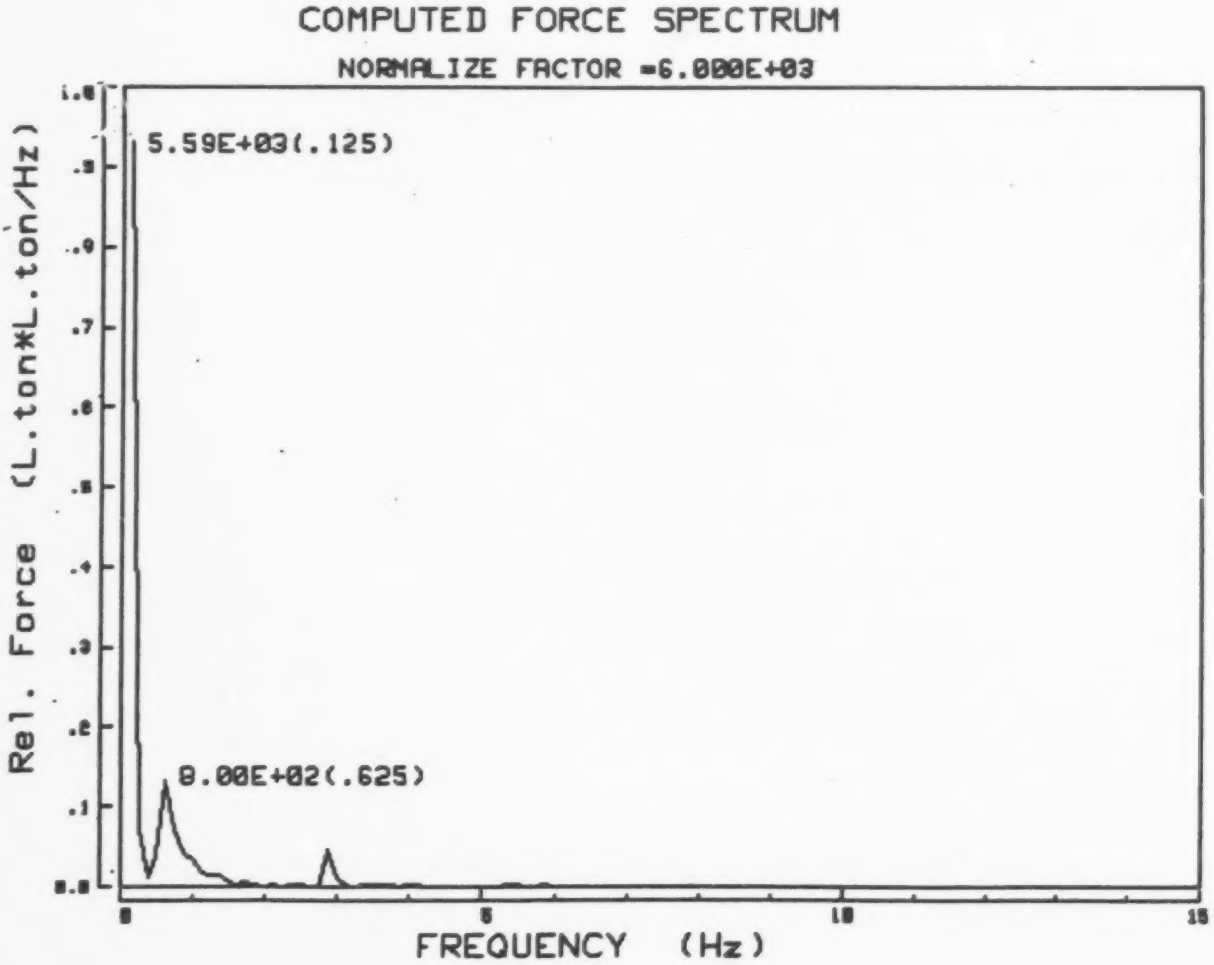


FIGURE 7.8h

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST -Transit Ramming 3'max L.I.
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (13:50)
Sensor  : ACC. 2Z                        Cal.Factor:1.2500('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F92Z4
* Location of applied conc. load is at section # 19.3
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 8.536102E+03(L.ton*L.ton)
  Root Mean Square= 9.239103E+01(L.ton)
```

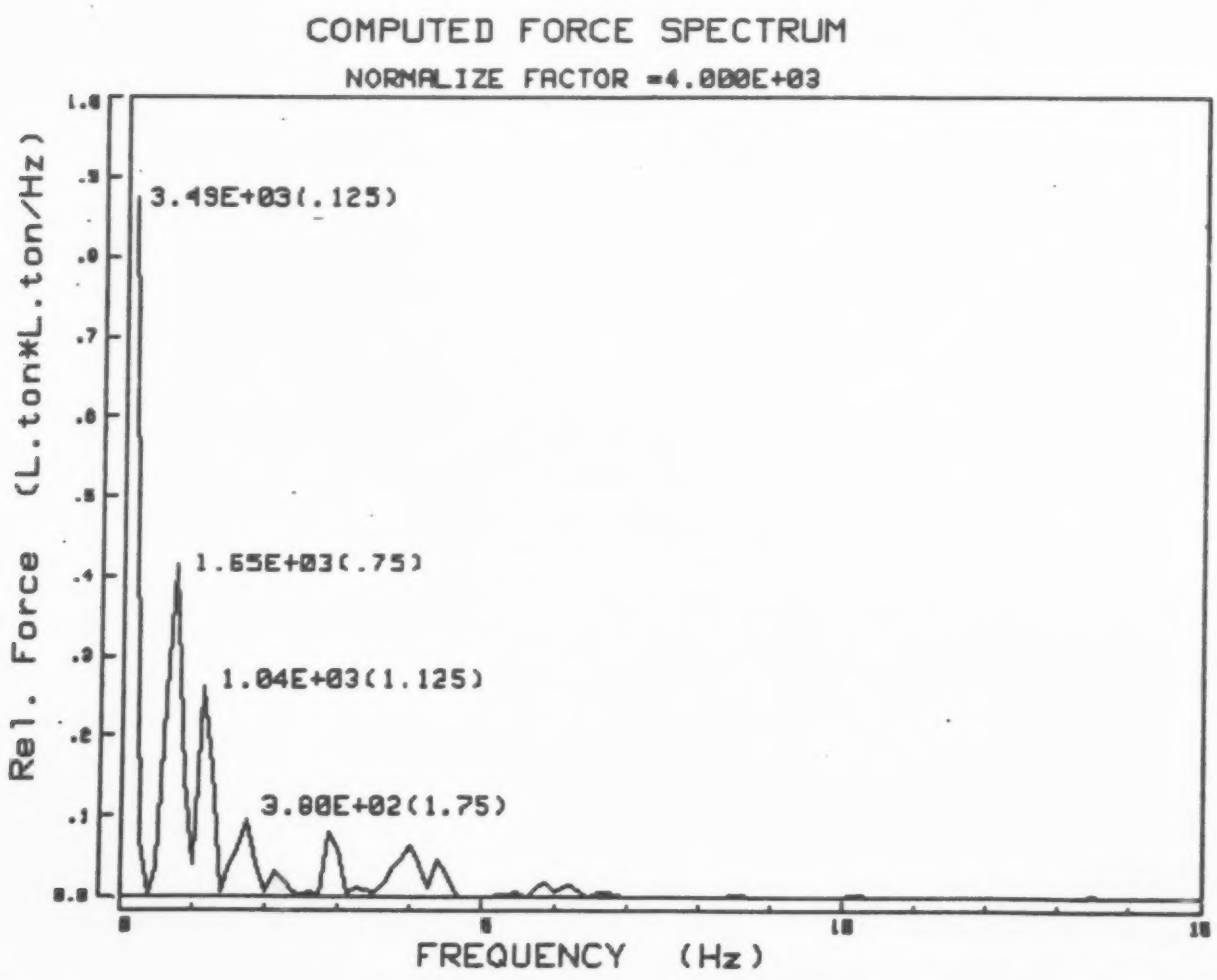


FIGURE 7.81

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST -Transit Ramming 3'max L.I.
Vessel  : USCGC POLAR SEA                  Test Time:FEB 9 1981 (13:50)
Sensor  : ACC. 5Z                          Cal.Factor:1.2422('g/v)
FreqRange:    50 (Hz)                      Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending                File Name: F95Z4
* Location of applied conc. load is at section # 19.3
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.150848E+03(L.ton*L.ton)
  Root Mean Square= 3.391236E+01(L.ton)
```

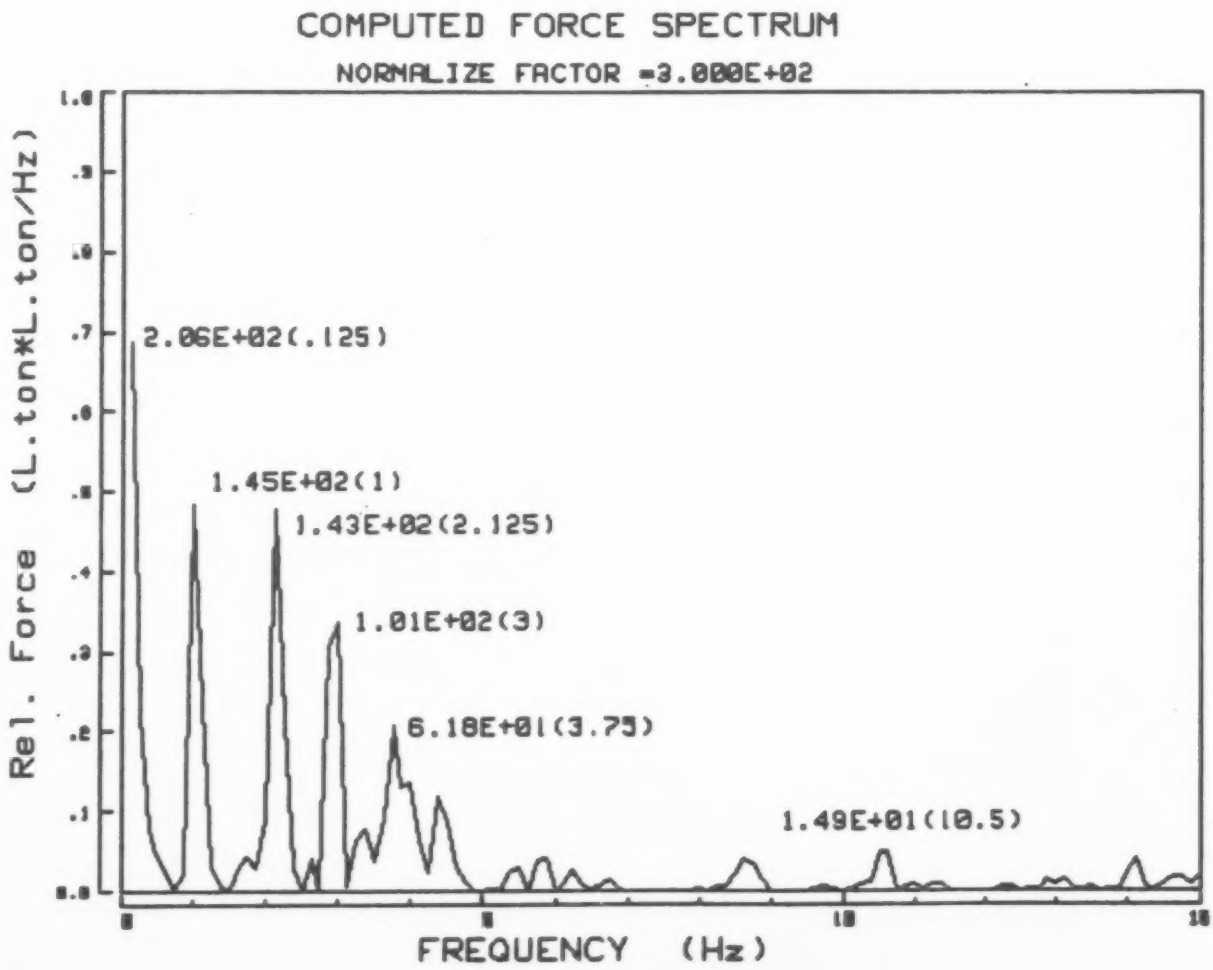


FIGURE 7.8j

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST -Transit Ramming 3'max L.I.
Vessel  : USCGC POLAR SEA                  Test Time:FEB 9 1981 (13:50)
Sensor  : ACC. 7Z                          Cal.Factor:1.2345('g/v)
FreqRange:    50 (Hz)                      Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending                File Name: F97Z4
* Location of applied conc. load is at section # 19.3
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)
```

Mean Square= 4.083021E+03(L.ton*L.ton)
Root Mean Square= 6.389852E+01(L.ton)

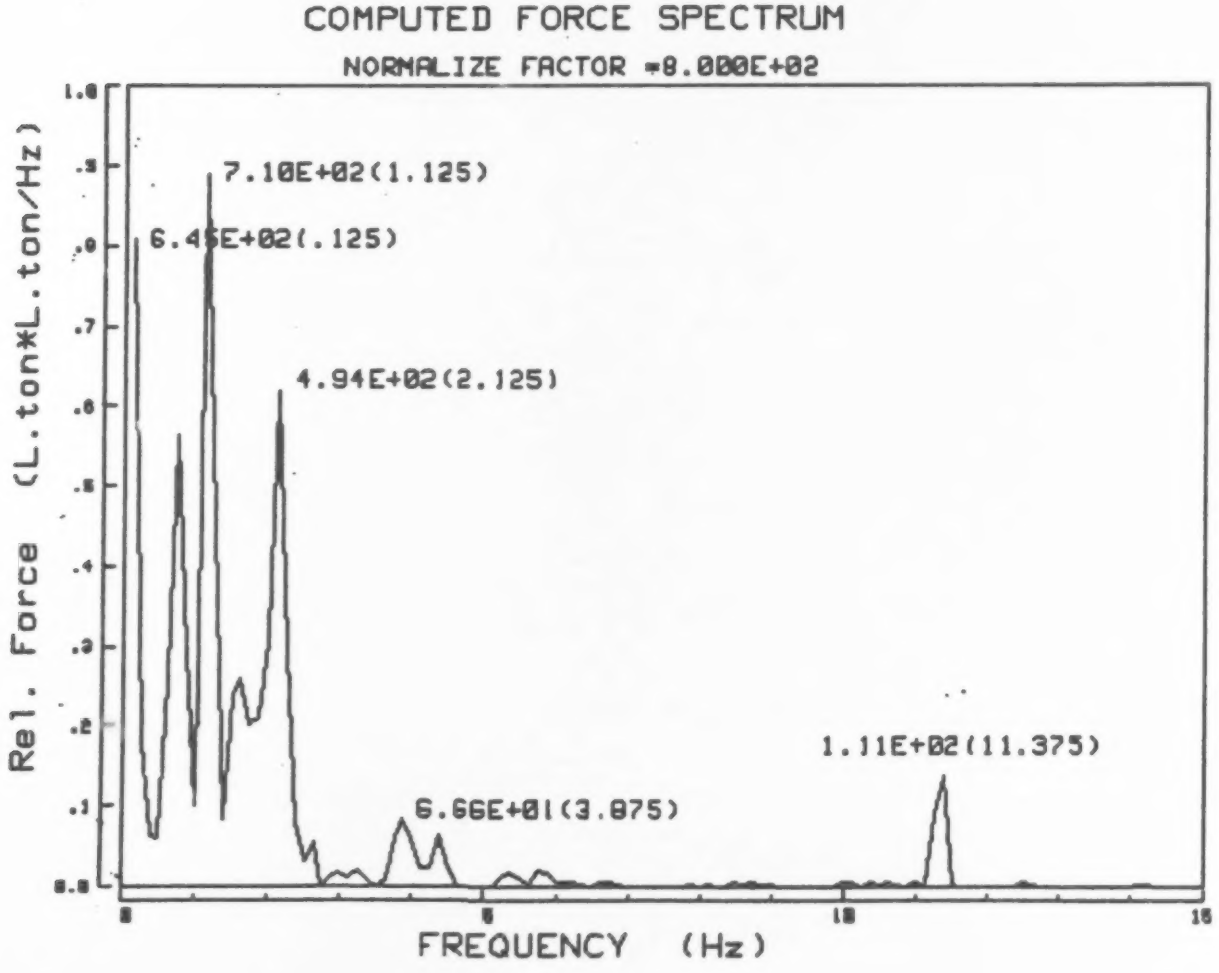


FIGURE 7.9a

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST - Ramming L.I. 3'max 2'avg
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (14:00)
Sensor  : ACC. 1Y                        Cal.Factor:1.1940('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F91Y5
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 20
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 3.622118E+03(L.ton*L.ton)
  Root Mean Square= 6.018404E+01(L.ton)
```

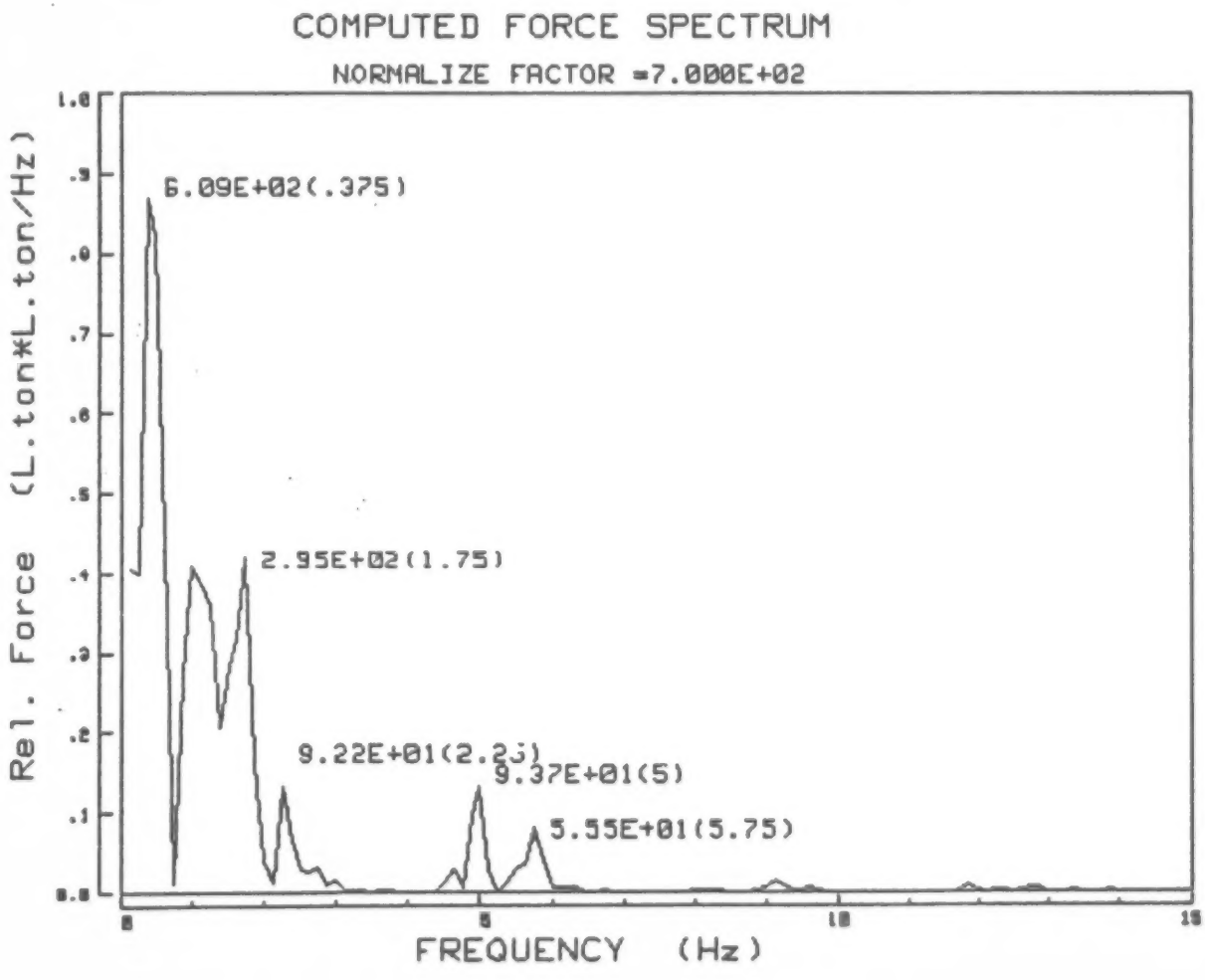


FIGURE 7.9b

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST - Ramming L.I. 3'max 2'avg
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (14:00)
Sensor  : ACC. 2Y                        Cal.Factor:1.2739('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F92Y5
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 7.243600E+03(L.ton*L.ton)
  Root Mean Square= 8.510934E+01(L.ton)
```

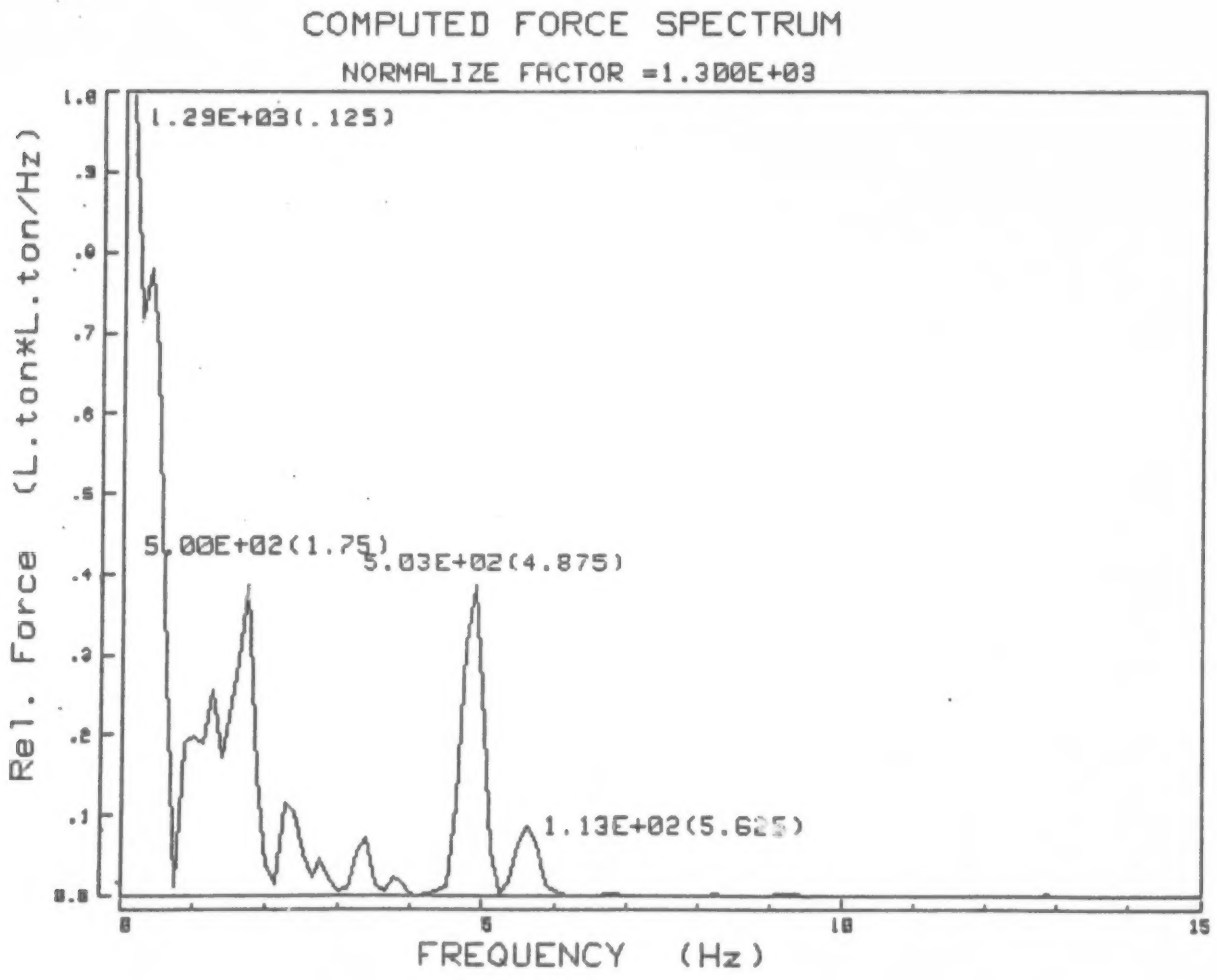


FIGURE 7.9c

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST - Ramming L.I. 3'max 2'avg
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (14:00)
Sensor  : ACC. 3Y                        Cal.Factor:1.2195('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F93Y5
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 16.14
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean        Square= 3.567112E+03(L.ton*L.ton)
  Root Mean Square= 5.972531E+01(L.ton)
```

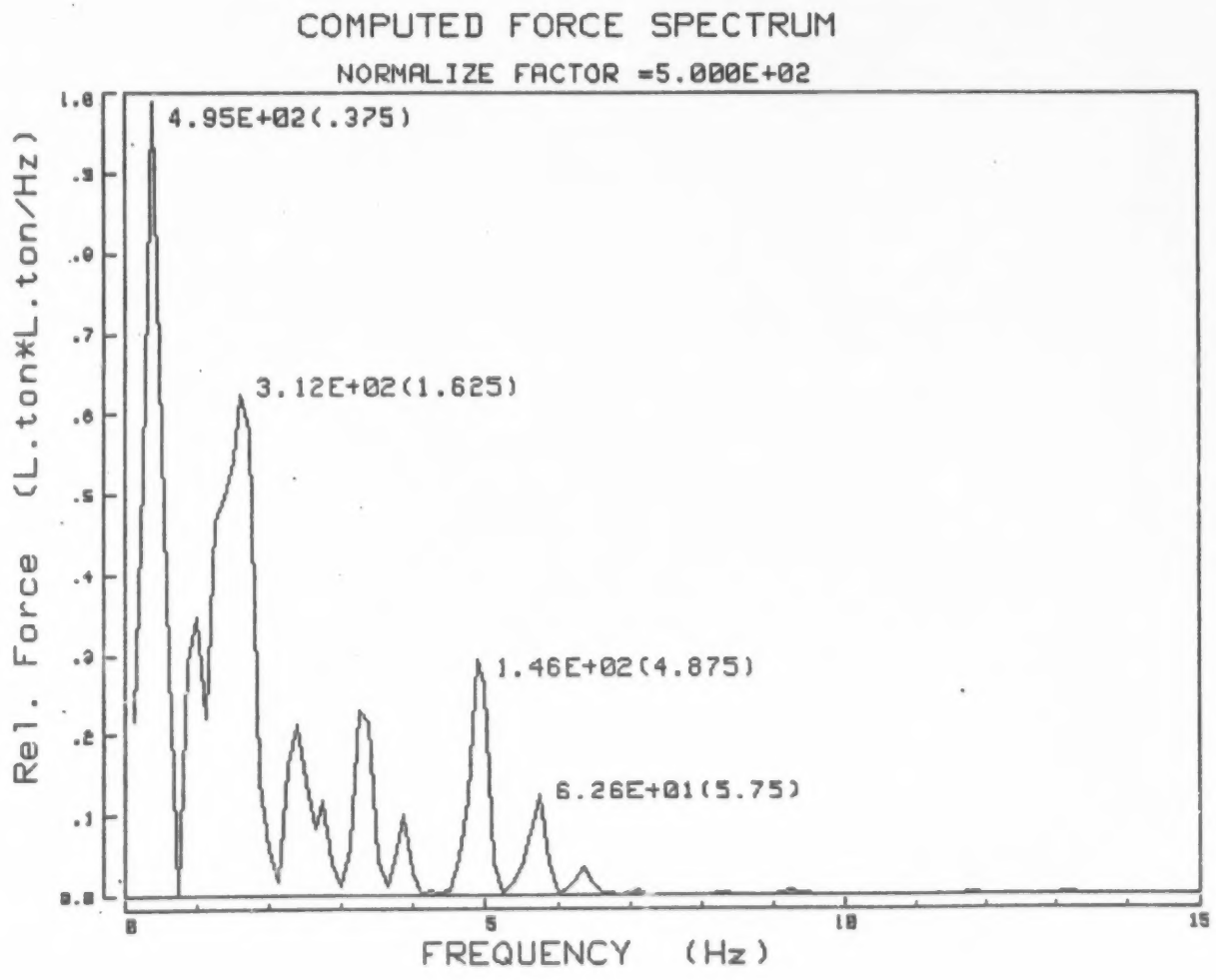


FIGURE 7.9d

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST - Ramming L.I. 3'max 2'avg
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (14:00)
Sensor  : ACC. 5Y                        Cal.Factor:1.2270('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F95Y5
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.555877E+03(L.ton*L.ton)
  Root Mean Square= 3.944461E+01(L.ton)
```

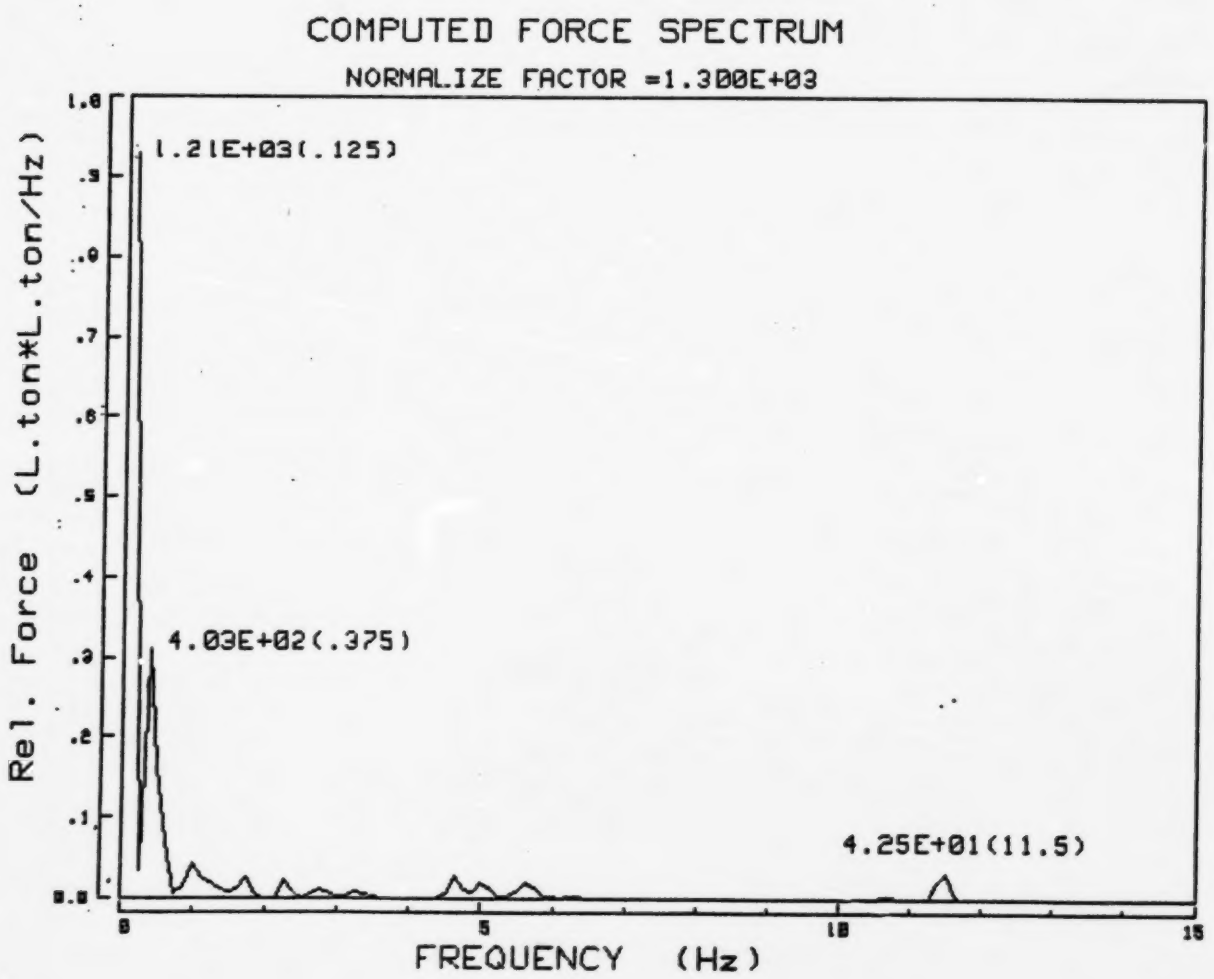


FIGURE 7.9e

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST - Ramming L.I. 3'max 2'avg
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (14:00)
Sensor  : ACC. 6Y                        Cal.Factor:1.2422('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending            File Name: F96Y5
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.610115E+03(L.ton*L.ton)
  Root Mean Square= 4.012623E+01(L.ton)
```

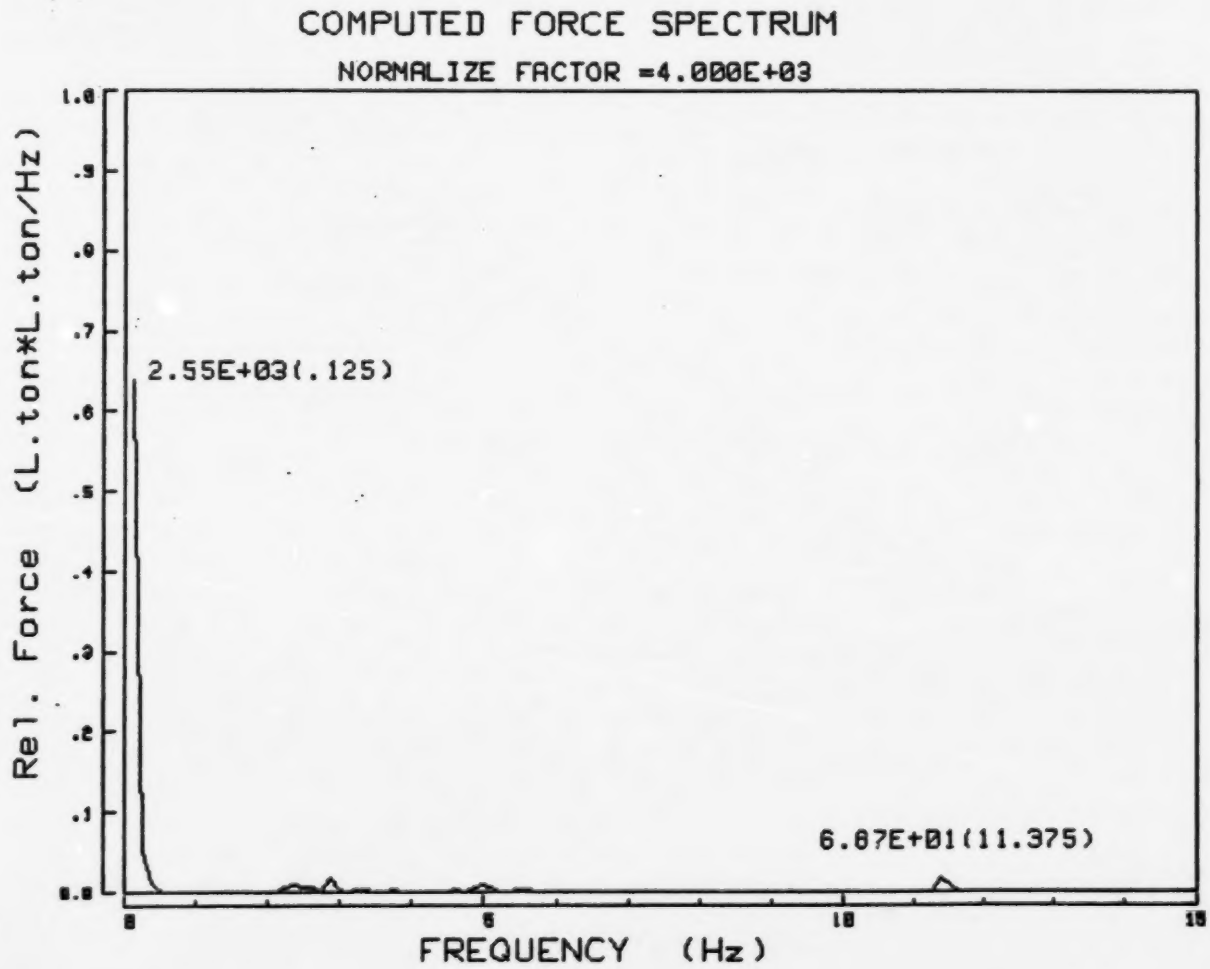


FIGURE 7.9f

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

Subject :POLAR SEA -F.S.TEST - Ramming L.I. 3'max 2'avg
Vessel : USCGC POLAR SEA Test Time:FEB 9 1981 (14:00)
Sensor : ACC. 7Y Cal.Factor:1.2270('g/v)
FreqRange: 50 (Hz) Force Unit: L.ton*L.ton/Hz
Vib. Mode: Horizontal Bending File Name: F97Y5
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)

Mean Square= 9.925452E+02(L.ton*L.ton)
Root Mean Square= 3.150468E+01(L.ton)

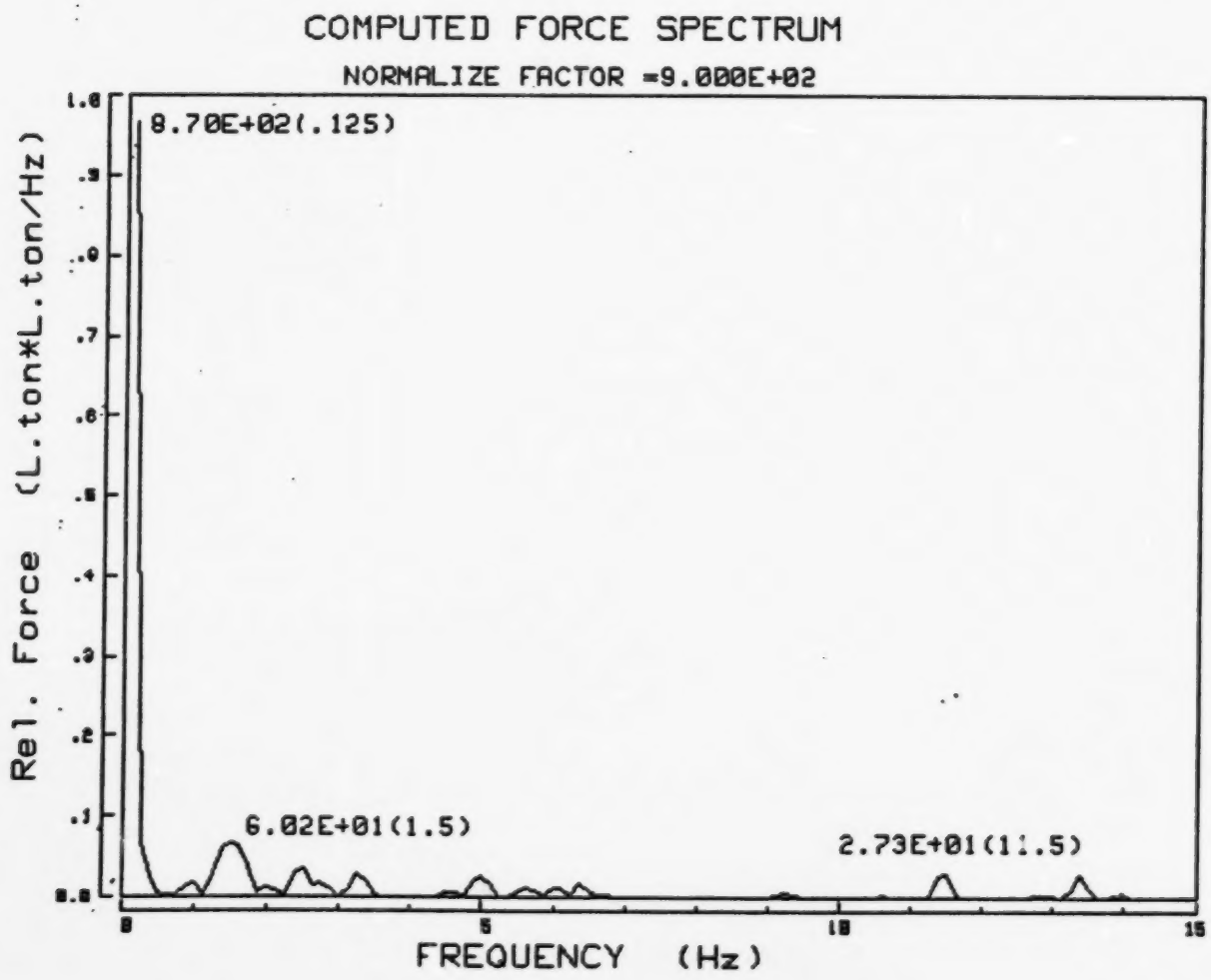


FIGURE 7.9g

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST - Ramming L.I. 3'max 2'avg
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (14:00)
Sensor  : ACC. 1Z                        Cal.Factor:1.2500('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F91Z5
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 20
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 2.711481E+03(L.ton*L.ton)
  Root Mean Square= 5.207189E+01(L.ton)
```

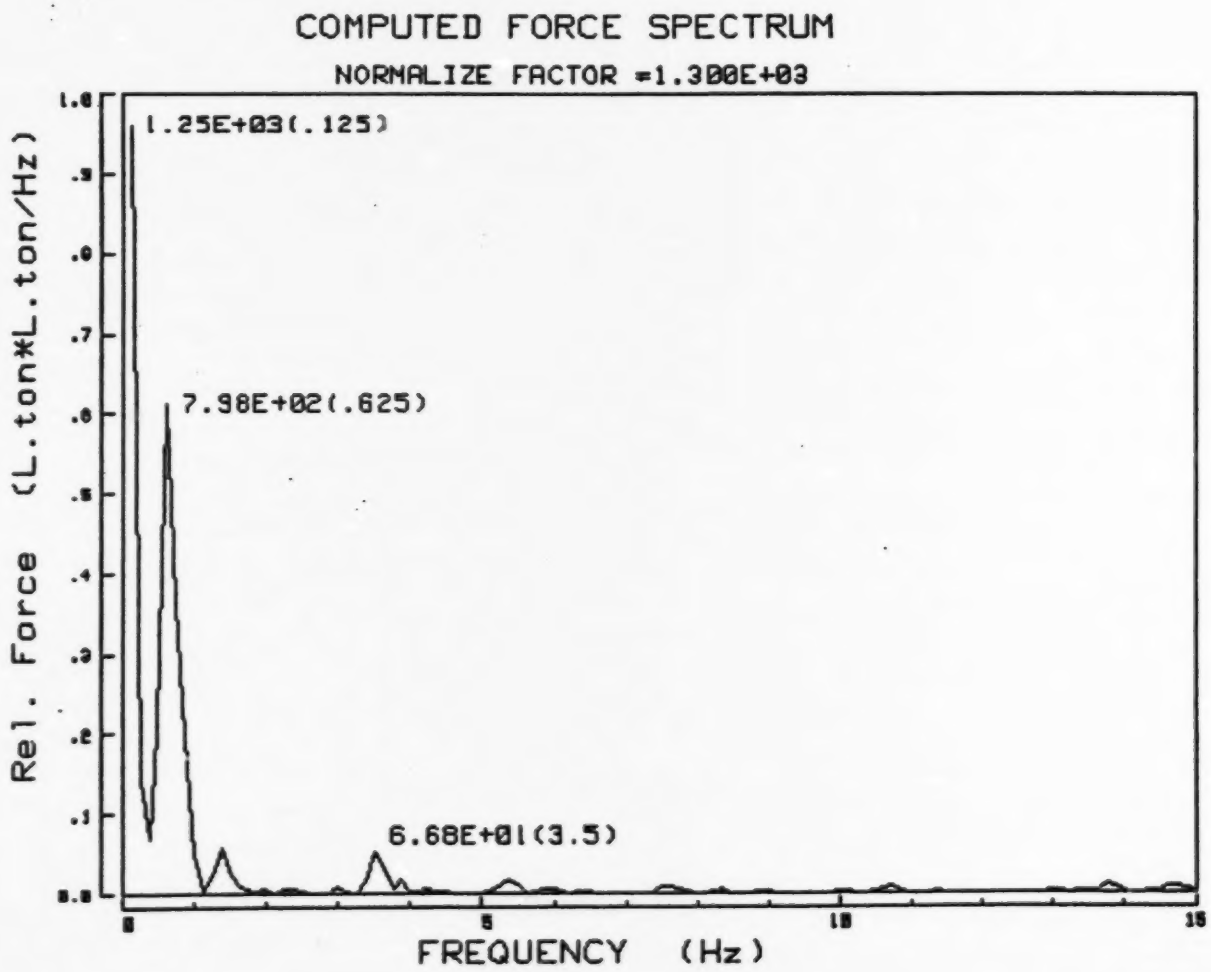


FIGURE 7.9h

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST - Ramming L.I. 3'max 2'avg
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (14:00)
Sensor  : ACC. 2Z                        Cal.Factor:1.2500('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F92Z5
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 16.4
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 7.117858E+03(L.ton*L.ton)
  Root Mean Square= 8.436740E+01(L.ton)
```

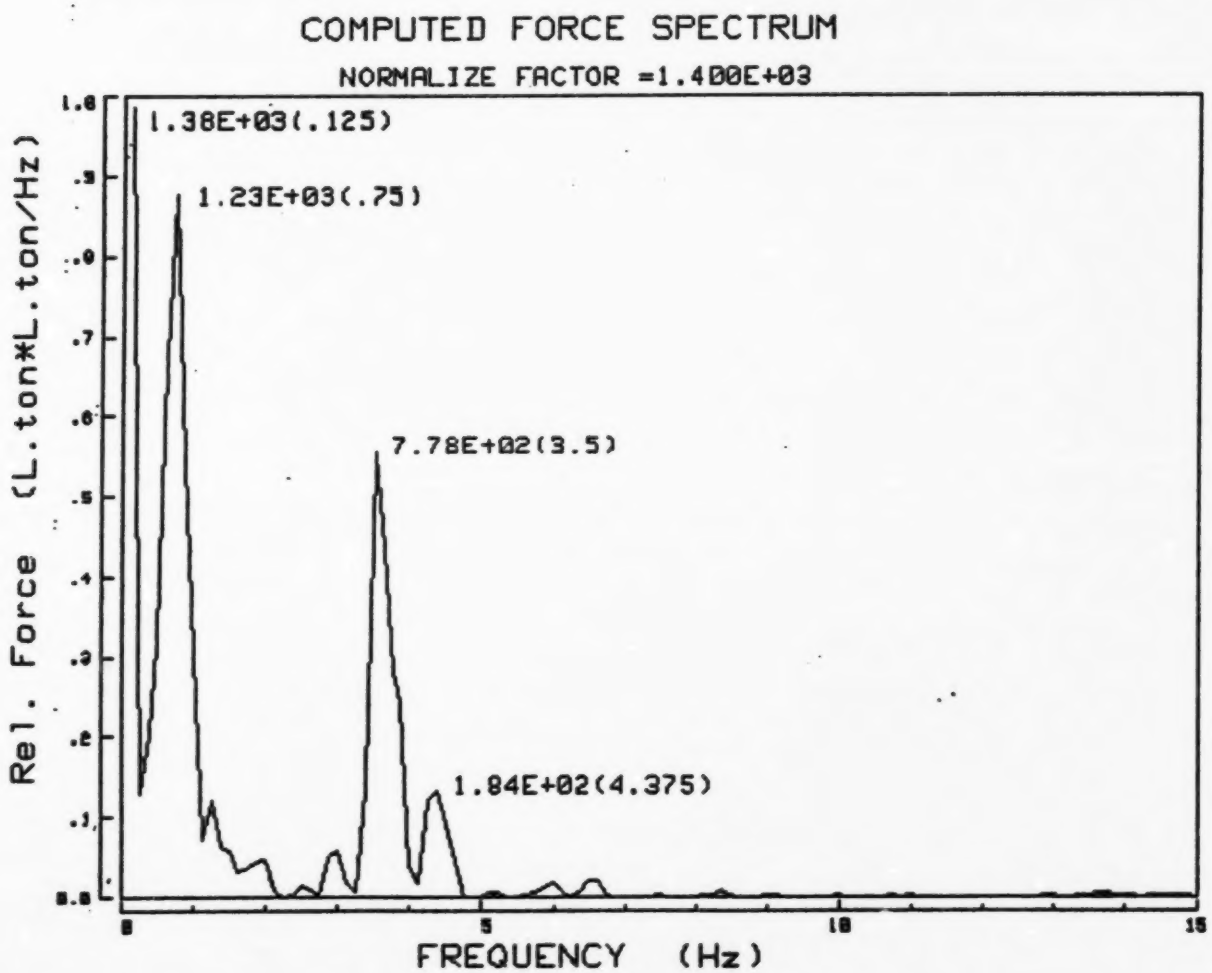


FIGURE 7.9i

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

```
Subject :POLAR SEA -F.S.TEST - Ramming L.I. 3'max 2'avg
Vessel  : USCGC POLAR SEA                Test Time:FEB 9 1981 (14:00)
Sensor  : ACC. 5Z                        Cal.Factor:1.2422('g/v)
FreqRange:    50 (Hz)                    Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending              File Name: F95Z5
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 7.6
* Cut-off frequency for force calculation is 15 (Hz)
```

```
  Mean      Square= 1.994057E+03(L.ton*L.ton)
  Root Mean Square= 4.465487E+01(L.ton)
```

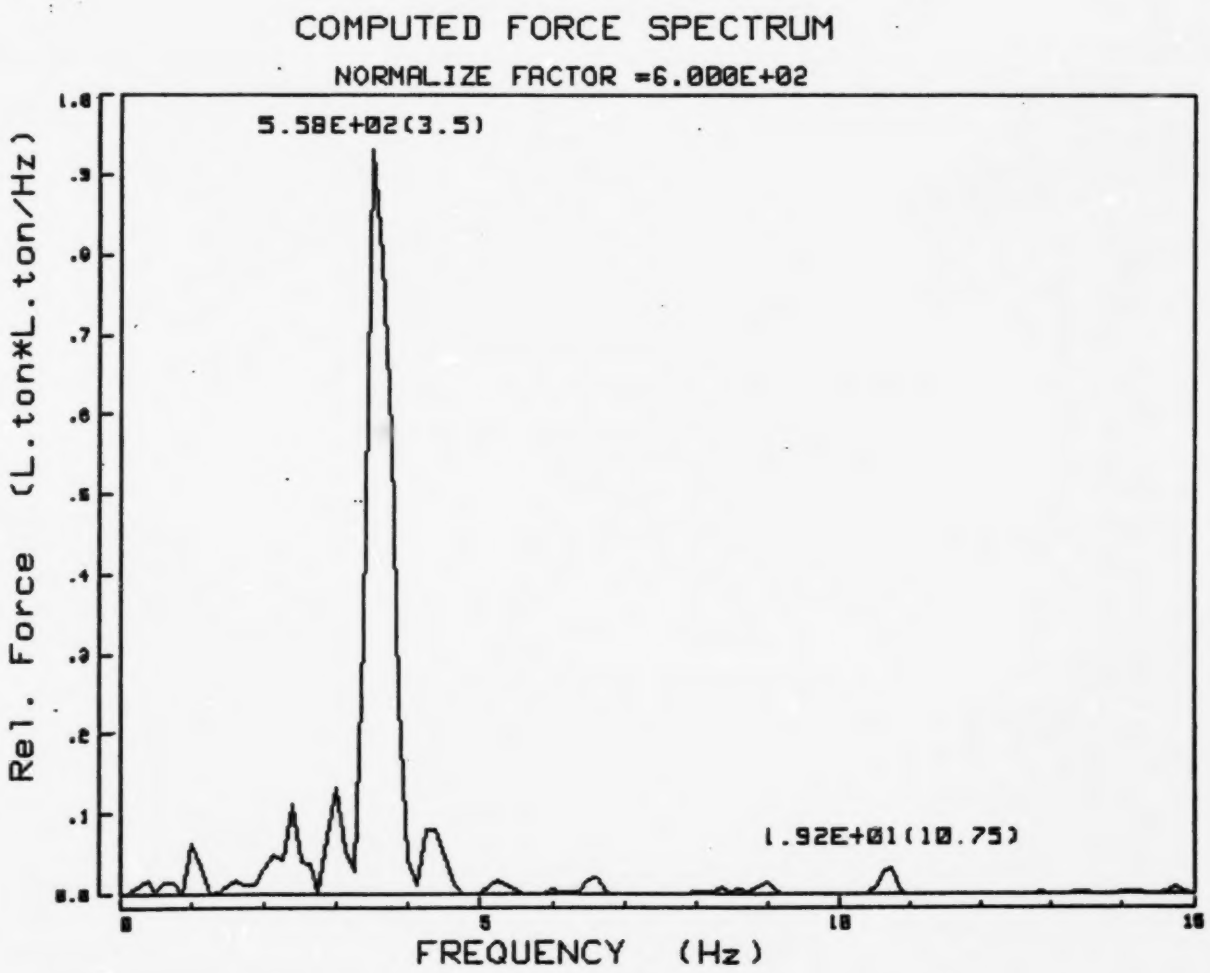


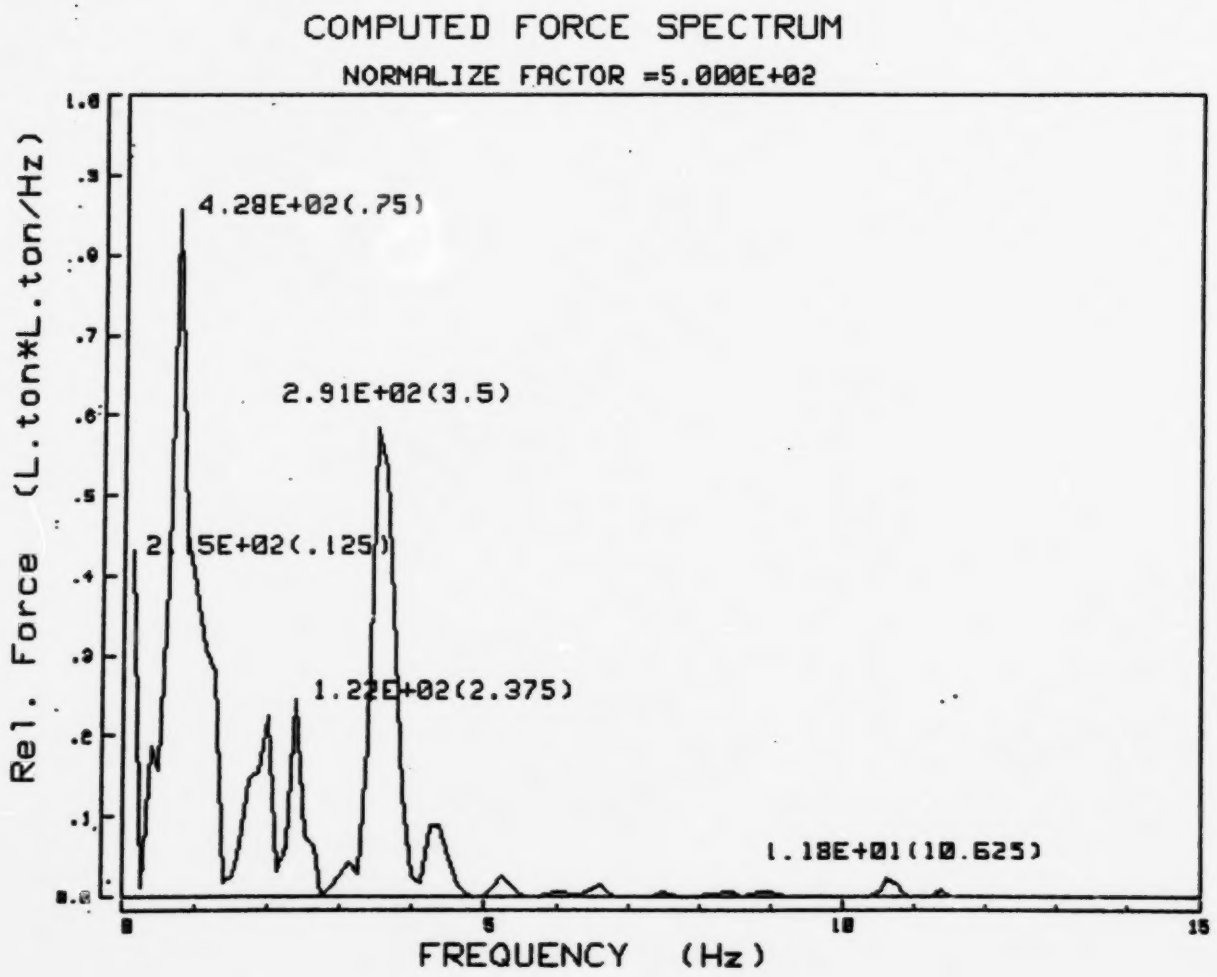
FIGURE 7.9j

ARCTEC CANADA LIMITED

FORCE SPECTRUM CALCULATION PROGRAM

Subject :POLAR SEA -F.S.TEST - Ramming L.I. 3'max 2'avg
Vessel : USCGC POLAR SEA Test Time:FEB 9 1981 (14:00)
Sensor : ACC. 7Z Cal.Factor:1.2345('g/v)
FreqRange: 50 (Hz) Force Unit: L.ton*L.ton/Hz
Vib. Mode: Vertical Bending File Name: F97Z5
* Location of applied conc. load is at section # 20
* Location of accelerometer is at section 2
* Cut-off frequency for force calculation is 15 (Hz)

Mean Square= 2.644067E+03(L.ton*L.ton)
Root Mean Square= 5.142049E+01(L.ton)



ANNEX 8

PROGRAM LISTINGS

```
10     ! 400-Q  : 400-LINE QUADRATURE (R/I) COMPONENT DATA TRANSMISSION PROGRAM
20     !  TRANSMIT SPECTRUM DATA FROM NICOLET SPECTRUM ANALYZER TO 9845B
30     !  USE '400-RI' PROGRAM TO INTERPRETATE DATA (CODE 6)
40     !
50     OPTION BASE 1
60     DIM A$(800)[7],B$(800)[5]
70     DIM Tit$[70],Ves$[30],Date$[30],Sen$[30]
80     PRINTER IS 16
90     PRINT PAGE,SPA(10),"400-Q : QUADRATURE (R/I)  DATA TRANSMISSION PROGRAM",L
IN(2)
100    INPUT "Job title ? (70 char. max.)",Tit$
110    INPUT "Vessel ? (30 char. max.)",Ves$,"Test date ? (30 char. max.)",Date$
120    INPUT "Sensor ? (30 char. max.)",Sen$,"Calibration constant ? (g'/v)",Cal
130    INPUT "Frequency range ?",Freq,"Sensitivity ?",Range
140 Zz1:   INPUT "File name to be called ? (5 char. max)",Nm$
150    ASSIGN #9 TO Nm$&":F8",Ret
160    IF NOT Ret THEN PRINT "*** FILE NAME IS IN USE."
170    IF NOT Ret THEN Zz1
180 Zz2: LINPUT "READY TO START ?",Ans$
190    IF NOT LEN(Ans$) THEN Zz2
200    PRINT SPA(10),"START"
210    REMOTE 7
220    SOUTPUT 730;"Q"
230    SENTER 730 USING "#,7A";A$(*)
240    PRINT SPA(20),"TRASFER DONE",LIN(2),SPA(10),"COPY TO B$"
250    FOR I=1 TO 800
260    B$(I)=A$(I)[1;5]
270    NEXT I
280    PRINT SPA(20),"COPY DONE",LIN(2),SPA(10),"STORE DATA"
290    CREATE Nm$&":F8",46
300    ASSIGN #1 TO Nm$&":F8"
310    PRINT #1;Tit$,Ves$,Date$,Sen$,Nm$,Freq,Range,Cal,B$(*)
320    CAT Nm$&":F8"
330    PRINT "JOB FINISHED."
340    END
```

```
10    ! 400-LINE QUADRATURE(R/I) SPECTRUM DATA INTERPRETATION & PLOTING PROGRAM
20    ! NICOLET FFTANALYZER COMMUNICATES WITH 45B THRU HP-IB BUS
30    !
40    OPTION BASE 1
50    DIM Power(400),Y(400),Rco(400),Ico(400),G(7)
60    DIM Tit$[70],Ves$[30],Date$[30],Sen$[30],A$(800)[5]
70    DIM Hex$(16)[4],Word$[16]
80    PRINTER IS 16
90    GCLEAR
100   PRINT PAGE,TAB(22),"ARCTEC  CANADA  LIMITED",LIN(1),TAB(10),"400-LINE SPEC
TRUM DATA INTERPRETATION PROGRAM",LIN(2)
110 Zz0:  INPUT "OPTION ? ('0' -format data and plot , '1' -plot data only.)",Io
120   IF NOT ((Io=0) OR (Io=1)) THEN Zz0
130 Zz1:   INPUT "FILE NAME WHICH CONSISTS THE DATA ?",Nm$
140   ASSIGN #9 TO Nm$&":F8",Ret
150   IF Ret THEN PRINT "FILE IS NOT IN DISC DIRECTORY."
160   IF Ret THEN Zz1
170   ASSIGN #1 TO Nm$&":F8"
180   IF Io=0 THEN READ #1;Tit$,Ves$,Date$,Sen$,Dfn$,Freq,Range,Cal,A$(*)
190   IF Io=1 THEN READ #1;Tit$,Ves$,Date$,Sen$,Dfn$,Freq,Range,Cal
200   CALL Head(0,Tit$,Ves$,Date$,Sen$,Dfn$,Freq,Range,Cal)
210 In: INPUT "Is the data file alright ? (Y or N)",As$
220   IF NOT (As$="Y") THEN In
230   Nam1$=Nm$&"r"&":F8"  !RESPONSE SPECTRAL DENSITY
240   Nam2$=Nm$&"i"&":F8"
250   Nam3$=Nm$&"p"&":F8"
260   Inn=400
270   IF Io THEN Goget
280   PRINT PAGE,"FORMAT DATA"
290   IF A$(1)[5;1]<>"6" THEN Zz9
300   READ Hex$(*)
310   DATA "0000","0001","0010","0011","0100","0101","0110","0111","1000","1001"
,"1010","1011","1100","1101","1110","1111"
320   READ G(*)
330   DATA .1,.2,.5,1.,2.,5.,10.
340   Code$="0123456789ABCDEF"
350   In=800
360   Ip=1
370   K=1
380   I=1
390 Start:   J=0
400   Word$=""
410   B$=A$(I)
420 Zz2:  J=J+1
430   N=POS(Code$,B$[J;1])
440   Word$=Word$&Hex$(N)
450   IF J<>4 THEN Zz2
460   ! DETERMINT 'MANTISSA'
470   Nm=13
480   Ma$=Word$[2,14]
490   IF VAL(Word$[1;1]) THEN Zz3
500   Im=1
510   GOTO Zz4
520 Zz3:   Im=-1
530   CALL Comp(Nm,Ma$,Mb$)
540   Ma$=Mb$
550 Zz4:   CALL Conv(Nm,Me,Ma$)
560   Man=Im*Me/2^Nm
570   ! SORT REAL/IMAGINARY COMPONENTS
580   ON Ip GOTO Real,Imag
590 Real:   Rco(K)=Man*Range
600   Ip=2
```

```
610   GOTO Nxt
620 Imag:   Ico(K)=Man*Range
630   Ip=1
640   K=K+1
650   IF I=In THEN Spe
660 Nxt:   I=I+1
670   GOTO Start
680 Spe: ! CALCULATE MAGNITUDE OF POWER SPECTRUM POINT
690   FOR L=1 TO Inn
700   Power(L)=Rco(L)*Rco(L)+Ico(L)*Ico(L)
710   NEXT L
720   Fcut=Freq
730   GOTO Plpr
740  !
750 Goget:   FREAD Nam3$,Power(*)
760   INPUT "Cut-off frequency for displaying spectrum (<=50) ?",Fcut
770   IF NOT Fcut THEN Fcut=Freq
780   Dfreq=Freq/Inn
790   Ncut=INT(Fcut/Dfreq/4)*4
800   Fcut=Ncut*Dfreq
810   REDIM Y(Ncut),Power(Ncut)
820   Inm=Inn
830   Inn=Ncut
840   !
850 Plpr:   !  FREQUENCY PLOT/PRINT FREQUENCY TABLE
860   PRINT LIN(2),"FREQUENCY PLOT/TABLE"
870   Cali=Cal*Cal
880   Ym=-99
890   FOR L=1 TO Inn
900   Ym=MAX(Ym,Power(L))
910   NEXT L
920   MAT Y=Power*(Cali)
930   Ym=Ym*Cali
940   CALL Head(1,Tit$,Ves$,Date$,Sen$,Dfn$,Freq,Range,Cal)
950   CALL Plot(Inn,Ym,Fcut,Y(*))
960   !
970   CALL Head(1,Tit$,Ves$,Date$,Sen$,Dfn$,Freq,Range,Cal)
980   CALL Table(Inn,Fcut,Y(*))
990   Inn=Inm
1000  PRINTER IS 16
1010  IF Io THEN Zz9
1020  ! STORE SPECTRUM DATA POINTS
1030  PRINT LIN(2),"** INSTALL DESTINATION FLOPPY. (Hit [CONT] to proceed.)"
1040  PAUSE
1050  A1=15
1060  CREATE Nm$&":F8",1
1070  ASSIGN #3 TO Nm$&":F8"
1080  PRINT #3;Tit$,Ves$,Date$,Sen$,Dfn$,Freq,Range,Cal
1090  FCREATE Nam1$,A1
1100  FPRINT Nam1$,Rco(*)
1110  FCREATE Nam2$,A1
1120  FPRINT Nam2$,Ico(*)
1130  FCREATE Nam3$,A1
1140  FPRINT Nam3$,Power(*)
1150 Zz9:  PRINT PAGE,LIN(5),TAB(20),"JOB  FINISHED"
1160  END
1170  SUB Conv(In,Ex,Can$)
1180  Cam$=REV$(Can$)
1190  Le=LEN(Cam$)
1200  IF Le>In THEN Yy1
1210  Ex=0
1220  k=1
1230 Yy0:  A=VAL(Cam$[K;1])
1240  Aa=2^(K-1)*A
1250  Ex=Ex+Aa
1260  IF K=Le THEN Yy1
```

```
1270  K=K+1
1280  GOTO Yy0
1290 Yy1:  SUBEND
1300  SUB Comp(In,Ca$,Cb$)
1310  DIM F(1:13),F$(1:13)
1320  F(1)=9
1330  F$(1)="9"
1340  FOR I=2 TO In
1350  F$(I)="8"&F$(I-1)
1360  F(I)=VAL(F$(I))
1370  NEXT I
1380  Ia=1
1390  A=VAL(Ca$[1;In])
1400  A0=1111111111110
1410  A1=A0-A
1420 Xx1:  A2=A1+Ia
1430  St$=REV$(VAL$(A2))
1440  N=POS(St$,"2")
1450  IF NOT N THEN Xx2
1460  IF N=In THEN Xx3
1470  Ia=F(N)
1480  GOTO Xx1
1490 Xx3:  PRINT "SUB Comp : data out of range."
1500  STOP
1510 Xx2:  Cb$=VAL$(A2)
1520  SUBEND
1530  SUB Head(Ih,Tit$,Ves$,Date$,Sen$,Dfn$,Freq,Range,Cal)
1540  IF Ih THEN PRINTER IS 0
1550  PRINT PAGE,LIN(2),TAB(28),"ARCTEC  CANADA  LIMITED",LIN(2),TAB(20),"400-LI
NE SPECTRUM DATA INTERPRETATION PROGRAM",LIN(2)
1560  PRINT "Subject :";Tit$
1570  PRINT USING "9A,X,30A,10A,30A";"Vessel  :",Ves$,"Test Time:",Date$
1580  PRINT USING "9A,X,30A,12A,X,M2D.4D,X,K";"Sensor  :",Sen$,"Calibration:",Ca
l,"(g/v)"
1590  PRINT USING "11A,5D,25X,10A,X,2D.3D,3A";"Frequency:",Freq,"Sen.Range:",Ran
ge,"(v)"
1600  PRINT USING "10A,X,5A";"File Name:";Dfn$
1610  PRINT LIN(2)
1620  SUBEND
1630  SUB Plot(Inn,Ym,Freq,Y(*))
1640  ON KEY #0 GOSUB Rig
1650  ON KEY #7 GOSUB Cent
1660  ON KEY #8 GOSUB Left
1670  ON KEY #15,10 GOTO Cont
1680  Gt=1.0E-6
1690 Xx0:  FOR L=1.0 TO 10
1700  Lim=L*Gt
1710  IF Ym>Lim THEN Xx1
1720  GOTO Xx2
1730 Xx1:  NEXT L
1740  Gt=Lim
1750  GOTO Xx0
1760 Xx2:  Ymm=Lim
1770  Ymax=1.0
1780  Xmin=0
1790  Ymin=0
1800  Xmax=Freq
1810  Dt=Freq/Inn
1820  Ytic=Ymax*.1
1830  Xtic=1.0
1840  !
1850  PLOTTER IS 13,"GRAPHICS"
1860  GRAPHICS
1870  LIMIT 0,184,0,140
1880  DEG
1890  SETGU
```

```
1900  MOVE 30,97
1910  LORG 2
1920  CSIZE 4
1930  LABEL "400-LINE ACCELERATION SPECTRUM"
1940  MOVE 40,92
1950  CSIZE 3
1960   LABEL USING "K,D.DE";"NORMALIZE FACTOR =",Ymm
1970  LOCATE 12,122,8,90
1980  SCALE Xmin,Xmax,Ymin,Ymax
1990  FRAME
2000  X=0
2010  FOR I=1.0 TO Inn
2020  X=X+Dt
2030  Yp=Y(I)/Ymm
2040  IF I=1.0 THEN MOVE X,Yp
2050  IF I=1.0 THEN Xx9
2060  DRAW X,Yp
2070 Xx9:  NEXT I
2080 Dig:  LORG 3
2090  CSIZE 3
2100   POINTER .5*Xmax,.5*Ymax
2110   DIGITIZE Ax,Ay
2120  GOTO Dig
2130 Left:  LORG 8
2140  Fa=-4*Dt
2150  GOTO Lab
2160 Cent:  LORG 4
2170  GOTO Lab
2180 Rig:  Fa=4*Dt
2190 Lab:  Nn=INT(Ax/Dt)
2200  Fm=1.0E-10
2210  IF Nn<=2 THEN Nn=2
2220  IF Nn>Inn-1.0 THEN Nn=Inn-1.0
2230  FOR I=1.0 TO 3
2240  N1=Nn-2+I
2250  IF Y(N1)>Fm THEN Nm=N1
2260  IF Y(N1)>Fm THEN Fm=Y(N1)
2270  NEXT I
2280  Nn=Nm
2290  Axx=Fa+Ax
2300  MOVE Axx,Ay
2310  LABEL USING "D.2DE,A,K,A";Y(Nn),"(",VAL$(Nn*Dt),")"
2320  RETURN
2330 Cont:  !
2340  LOCATE 12,122,6.5,7.5
2350  SCALE Xmin,Xmax,0,1.0
2360  MOVE Xmin,0
2370  DRAW Xmax,0
2380  CSIZE 2
2390  LDIR 0
2400  LORG 6
2410  Ix=0
2420  FOR Px=Xmin TO Xmax STEP Xtic
2430  IF Ix THEN Half
2440  MOVE Px,0
2450  DRAW Px,1.0
2460  MOVE Px,-.9
2470  LABEL USING "2D";Px
2480  Ix=4
2490  GOTO Nex
2500 Half:  MOVE Px,0
2510  DRAW Px,.6
2520  Ix=Ix-1.0
2530 Nex:  NEXT Px
2540  SETGU
2550  LOCATE 10,11,8,90
```

```
2560  SCALE 0,1.0,Ymin,Ymax
2570  MOVE 0,Ymin
2580  DRAW 0,Ymax
2590  LORG 8
2600  FOR Py=Ymin TO Ymax STEP Ytic
2610  IF Py=Ymax THEN LORG 9
2620  MOVE 0,Py
2630  DRAW 1.0,Py
2640  MOVE 0,Py
2650  LABEL USING "D.D,X";Py
2660  NEXT Py
2670  SETGU
2680  LORG 6
2690  CSIZE 4
2700  MOVE 60,3
2710  LABEL "FREQUENCY  (Hz)"
2720  MOVE 2,20
2730  LORG 2
2740  LDIR 90
2750  LABEL "Rel. Acceleration ('g*'g/Hz)"
2760  !
2770   DUMP GRAPHICS
2780 Pltend:  EXIT GRAPHICS
2790  SUBEND
2800  SUB Table(Inn,Freq,Y(*))
2810  DIM Aa$[20]
2820  PRINT SPA(25),"400-LINE  ACCELERATION SPECTRUM",LIN(1),SPA(29),"(Amplitude
 in 'g*'g/Hz)"
2830  Aa$="  Hz    Amplitude "
2840  PRINT USING "/,K,/,3X,4(17A,2X),/,K,/";RPT$("-",80),Aa$,Aa$,Aa$,Aa$,RPT$("
-",80)
2850  Dt=Freq/Inn
2860  Line=INT(Inn/4)
2870  FOR J=1 TO Line
2880  I=4*(J-1)+1
2890  F1=I*Dt
2900  F2=F1+Dt
2910  F3=F2+Dt
2920  F4=F3+Dt
2930  PRINT USING "3X,4(2D.3D,X,D.4DE,2X)";F1,Y(I),F2,Y(I+1),F3,Y(I+2),F4,Y(I+3)
2940  NEXT J
2950  PRINT LIN(1),RPT$("-",80)
2960  SUBEND
```

```
10     ! 400FSC - 400-LINE FORCE SPECTRUM CALCULATION PROGRAM
20     ! PROGRAM FUNCTION : Calculate force spectrum from measurec response
30     !                     spectrum.
40     ! ENGINEER          : B. Menon & G. TAM
50     ! PROJECT           : 792C (USCGC POLAR SEA VIBRATION ANALYSIS)
60     ! DATE              : JUN 8,1981
70     !
80     OPTION BASE 1
90     DIM Nac(400),Force(400),Mode(10,20),Mu(20),Fn(10),Wn(10),Mn(10),Phi(10)
100    DIM Tit$[70],Ves$[30],Date$[30],Sen$[30]
110    DIM Ri$(2)[1],Pol(400),Sea(400),Rco(400),Ico(400)
120    COM Fcut,Ximp,Px,Ms,Rms
130    PRINTER IS 16
140    GCLEAR
150    M$=":F8"
160    Ri$(1)="r"
170    Ri$(2)="i"
180    In=400
190    Ntest=0
200    PRINT PAGE,SPA(28),"ARCTEC  CANADA  LIMITED",LIN(1),SPA(16),"400-LINE FORC
E SPECTRUM CALCULATION PROGRAM",LIN(2)
210    INPUT "Number of sections of the ship ?",Ns,"Number of natural frequencies
 ?",Nf
220    IF Ns>20 THEN PRINT "Number os section is out of range."
230    IF Nf>10 THEN PRINT "Number of natural grequency is out of range."
240    IF (Ns>20) OR (Nf>10) THEN STOP
250    REDIM Mode(Nf,Ns),Mu(Ns),Fn(Nf),Wn(Nf),Mn(Nf),Phi(Nf)
260    INPUT "Type of vibration ? (1-Vertical[Z], 2-Horizontal[Y])",Type
270    PRINT "ENTER MODE SHAPES,NATURAL FREQUENCIES, AND DISTRIBUTED MASS DATA FO
R THE VESSEL."
280    LINPUT "Source of data ? (M -Mass storage, T -Terminal)",Mt$
290    Mt$=UPC$(Mt$)
300    Mt=POS("MT",Mt$)
310    ON Mt GOTO Mass,Term
320 Mass:   LINPUT "Enter file name ?",Nn$
330    ASSIGN #9 TO Nn$&M$,Ret
340    IF NOT Ret THEN Zz0
350    PRINT "FILE IS NOT IN THEN DIRECTORY."
360    GOTO Mass
370 Zz0:   READ #9;Dx,Fn(*),Mu(*),Mode(*)
380    GOTO Zz1
390 Term:  INPUT "Length of section ?",Dx
400    PRINT PAGE,"A) Enter natural frequencies.",LIN(1)," NODES      FREQUENCY
 (Hz) "
410    FOR I=1 TO Nf
420    INPUT "Natural Frequency (Hz) ?",Fn(I)
430    PRINT USING "4X,DD,10X,3D.4D";I-1,Fn(I)
440    NEXT I
450    PRINT LIN(1),"B) Enter 'Distributed mass' for each section.",LIN(1),"
 Section No       Mass/unit length "
460    FOR I=1 TO Ns
470    INPUT "Mass/unit length?",Mu(I)
480    PRINT USING "8X,2D,13X,3D.4D";I,Mu(I)
490    NEXT I
500    WAIT 2000
510    FOR I=1 TO Nf
520    PRINT PAGE,"ENTER MODE SHAPE FOR ";VAL$(I-1);" NODES :",LIN(1),"   Secti
on #     Rel.Amplitude   "
530    FOR J=1 TO Ns
540    INPUT "Input Rel. Amplitude ?",Mode(I,J)
```

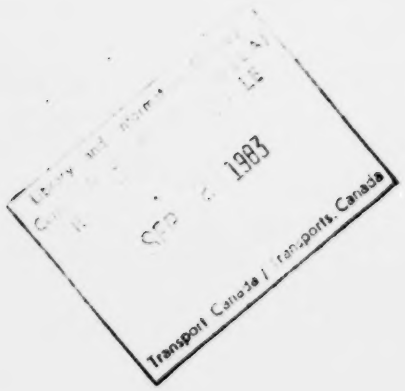
```
550     PRINT USING "8X,2D,9X,MD.5D";J,Mode(I,J)
560     NEXT J
570     WAIT 2000
580     NEXT I
590     INPUT "LIKE TO STORE ABOVE INPUT ?",Yn$
600     IF NOT (Yn$="Y") THEN Zz1
610     INPUT "FILE NAME TO BE USED ?",Fnm$
620     CREATE Fnm$&M$,6
630     ASSIGN #9 TO Fnm$&M$
640     PRINT #9;Dx,Fn(*),Mu(*),Mode(*)
650 Zz1: INPUT "Location of the concentrated impact force (Bow=Section 20, Stern
=section 1) ?",Ximp
660     IF (Ximp<1) OR (Ximp>20) THEN PRINT "INCORRECT INPUT."
670     IF (Ximp<1) OR (Ximp>20) THEN Zz1
680 Restart: MAT Force=ZER
690 Zz2:     INPUT "Location of sensor (in terms of 'section') ?",Px
700     IF (Px<1) OR (Px>20) THEN PRINT "Location of sensor is out of range."
710     IF (Px<1) OR (Px>20) THEN Zz2
720 Zz3:    INPUT "FILE NAME WHICH CONTAINS THE ACCELERATION SPECTRAL DENSITY DAT
A ?",Nm$
730     ASSIGN #9 TO Nm$&M$,Ret
740     IF Ret THEN PRINT "FILE IS NOT IN THE DIRECTORY."
750     IF Ret THEN Zz3
760     ASSIGN #1 TO Nm$&M$
770     READ #1;Tit$,Ves$,Date$,Sen$,Dfn$,Freq,Range,Cal
780     CALL Head(0,Tit$,Ves$,Date$,Sen$,Dfn$,Freq,Cal,Type)
790     INPUT "IS THE DATA FILE ALRIGHT ?",An$
800     IF NOT (An$="Y") THEN Zz3
810     INPUT "Cut-off frequency for force spectrum calculation ?",Fcut
820     IF NOT Fcut THEN Fcut=Freq
830     Dfreq=Freq/In
840     Ncut=INT(Fcut/Dfreq/4)*4
850     Fcut=Ncut*Dfreq
860     REDIM Force(Ncut)
870     Inn=In
880     In=Ncut
890     PRINT PAGE,"RETRIEVE QUADRATURE (R/I) COMPONENTS OF RESPONSE SPECTRUM DATA
 ."
900     FOR I=1 TO 2
910     Nam1$=Nm$&Ri$(I)&M$
920     Nam2$=LWC$(Nm$[4;1])
930     Nam2$=Nm$[1;3]&Nam2$&Nm$[5;1]&Ri$(I)&M$
940     FREAD Nam1$,Pol(*)
950     FREAD Nam2$,Sea(*)
960     IF I=1 THEN MAT Rco=Pol-Sea
970     IF I=2 THEN MAT Ico=Pol-Sea
980     NEXT I
990     ! CALCULATE SPECTRAL DENSITY
1000    FOR J=1 TO In
1010    Nac(J)=Rco(J)*Rco(J)+Ico(J)*Ico(J)
1020    NEXT J
1030    !
1040    PRINT SPA(20),"DATA TRANSFER COMPLETED.",LIN(2),"CALCULATE FORCE SPECTRAL
DENSITY."
1050    ! CALCULATE SPECTRAL DENSITY OF FORCE
1060    OVERLAP
1070    IF Ntest THEN PRINTER IS 0
1080    Con=32.174    !STD. ACCLERATION OF GRAVITY
1090    Can=2*PI
1100    Xi=.003   ! DAMPING COEFFICIENT
1110    Cal=Cal*Cal*Con*Con
1120    I=0
1130    Om=0
1140    Dom=Dfreq*Can
1150 Zz4:   I=I+1
1160    Om=Om+Dom
```

```
1170  N=0
1180  Sum=0
1190  IF Ntest THEN PRINT "I=";I;"OM=";Om !
1200 Zz5:  N=N+1
1210  IF I<>1 THEN Zz6
1220  ! CALCULATE GENERALIZED MASS
1230  Sam=0
1240  FOR M=1 TO Ns
1250  Mas=2*Mu(M)*Mode(N,M)*Mode(N,M)
1260  IF (M=1) OR (M=Ns) THEN Mas=Mas*.5
1270  Sam=Sam+Mas
1280  NEXT M
1290  Mn(N)=.5*Dx*Sam
1300  ! M=1 :CALCULATE MODE PARTICIPATION OF LOAD, M=2 :CALCULATE MODE SHAPE AMP
LITUDE AT 'Px'
1310  FOR M=1 TO 2
1320  IF M=1 THEN X1=INT(Ximp)
1330  IF M=1 THEN Xx=Ximp
1340  IF M=2 THEN X1=INT(Px)
1350  IF M=2 THEN Xx=Px
1360  IF X1=Ns THEN Ph=Mode(N,X1)
1370  IF X1=Ns THEN Zz6a
1380  Xu=X1+1
1390  S1=Mode(N,Xu)-Mode(N,X1)       ! (XU-XL) ALWAYS UNITY
1400  Ph=Mode(N,X1)+S1*(Xx-X1)
1410 Zz6a:  IF M=1 THEN Wn(N)=Ph
1420  IF M=2 THEN Phi(N)=Ph
1430  NEXT M
1440 Zz6:  ! SUMMATION
1450  IF Ntest THEN PRINT "N=";N;"Wn=";Wn(N);"Mn=";Mn(N);"Phi=";Phi(N);"Sum=";Su
m !
1460   Omn=Fn(N)*Can
1470  Arg=(1-(Om/Omn)^2)^2+Xi*Xi
1480  Brg=Mn(N)*Mn(N)*Omn*Omn*Omn*Omn*Arg
1490  Crg=Wn(N)*Wn(N)*Phi(N)*Phi(N)/Brg
1500  Sum=Sum+Crg
1510  IF Ntest THEN PRINT "ARG=";Arg;"BRG=";Brg;"CRG=";Crg;"SUM=";Sum !
1520  IF N>=Nf THEN Zz7
1530  GOTO Zz5
1540 Zz7:  ! CLACULATE FORCE AMPLITUDE
1550  Force(I)=Nac(I)*Cali/(Om*Om*Om*Om*Sum)
1560  IF Ntest THEN PRINT "I=";I;"OM=";Om;"Force=";Force(I);"Nac=";Nac(I);"C.Nac
";Nac(I)*Cal*Cal,LIN(1)     !
1570  IF I>=In THEN Zz8
1580  GOTO Zz4
1590 Zz8:  ! CALCULATE MEAN SQUARE AND RMS VALUES
1600  Ms=.5*Dom*(2*SUM(Force)-Force(1)-Force(In))
1610  Rms=SQR(Ms)
1620  ! PLOT/PRINT TABLE/STORE DATA
1630  SERIAL
1640  PRINT SPA(20),"FORCE SPECTRUM CALCULATION COMPLETED.",LIN(2),"DO GRAPHICS"
1650  Ym=-99
1660  FOR L=1 TO Ncut
1670  Ym=MAX(Ym,Force(L))
1680  NEXT L
1690  CALL Head(1,Tit$,Ves$,Date$,Sen$,Dfn$,Freq,Cal,Type)
1700  CALL Plot(In,Ym,Fcut,Force(*))
1710  !
1720  CALL Head(1,Tit$,Ves$,Date$,Sen$,Dfn$,Freq,Cal,Type)
1730  CALL Table(In,Fcut,Force(*))
1740  !
1750   A1=15
1760   Nam3$=Nm$&"f"&M$
1770   FCREATE Nam3$,A1
1780   FPRINT Nam3$,Force(*)
1790   !
```

```
1800 Zz9:  PRINTER IS 16
1810  PRINT SPA(20),"DATA TRANSFER COMPLETED.",LIN(2)
1820  In=Inn
1830  INPUT "LIKE TO PROCEED FOR A NEXT RUN ?",Y$
1840  IF UPC$(Y$)="Y" THEN Restart
1850  PRINT PAGE,LIN(5),TAB(20),"*** JOB  FINISHED ***"
1860  END
1870  SUB Head(Ih,Tit$,Ves$,Date$,Sen$,Dfn$,Freq,Cal,Type)
1880  COM Fcut,Ximp,Px,Ms,Rms
1890  DIM A$[28]
1900  IF Ih THEN PRINTER IS 0
1910  IF Type=1 THEN A$="Vertical Bending"
1920  IF Type=2 THEN A$="Horizontal Bending"
1930  PRINT PAGE,LIN(5),TAB(28),"ARCTEC  CANADA  LIMITED",LIN(2),TAB(22),"FORCE
SPECTRUM CALCULATION PROGRAM",LIN(2)
1940  PRINT "Subject :";Tit$
1950  PRINT USING "9A,X,30A,10A,30A";"Vessel  :",Ves$,"Test Time:",Date$
1960  PRINT USING "9A,X,29A,X,11A,D.4D,6A";"Sensor  :",Sen$,"Cal.Factor:",Cal,"(
'g/v)"
1970  PRINT USING "11A,5D,5A,19X,K";"FreqRange:",Freq," (Hz)","Force Unit: L.ton
*L.ton/Hz"
1980  PRINT USING "10A,X,28A,X,10A,X,5A";"Vib. Mode:",A$,"File Name:",Dfn$
1990  IF NOT Ih THEN Send
2000  PRINT "* Location of applied conc. load is at section # ";VAL$(Ximp),LIN(1
),"* Location of accelerometer is at section ";VAL$(Px)
2010  PRINT "* Cut-off frequency for force calculation is ";VAL$(Fcut);" (Hz)",L
IN(1),RPT$("-",80),LIN(1)
2020  PRINT USING Fmt;"Mean       Square=",Ms,"(L.ton*L.ton)"
2030  PRINT USING Fmt;"Root Mean Square=",Rms,"(L.ton)"
2040 Fmt:  IMAGE 2X,17A,X,D.6DE,K
2050  PRINT RPT$("-",80)
2060 Send: SUBEND
2070  SUB Plot(In,Ym,Freq,Force(*))
2080  DIM Lim(1.0:21)
2090  ON KEY #0 GOSUB Rig
2100  ON KEY #7 GOSUB Cent
2110  ON KEY #8 GOSUB Left
2120  ON KEY #15,10 GOTO Cont
2130  Gt=5.0
2140 Xx0:  FOR L=1.0 TO 20
2150  Lim=Gt*L
2160  IF Ym>Lim THEN Xx1
2170  GOTO Xx2
2180 Xx1:  NEXT L
2190  Gt=Lim
2200  GOTO Xx0
2210 Xx2:  Ymm=Lim
2220  Ymax=1.0
2230  Xmin=0
2240  Ymin=0
2250  Xmax=Freq
2260  Df=Freq/In
2270  Ytic=Ymax*.1
2280  Xtic=1.0
2290  !
2300  PLOTTER IS 13,"GRAPHICS"
2310  GRAPHICS
2320  LIMIT 0,184,0,140
2330  DEG
2340  SETGU
2350  MOVE 30,97
2360  LORG 2
2370  CSIZE 4
2380  LABEL "COMPUTED FORCE SPECTRUM"
2390  MOVE 34,92
2400  CSIZE 3
```

```
2410   LABEL USING "K,D.3DE";"NORMALIZE FACTOR =",Ymm
2420  LOCATE 12,122,8,90
2430  SCALE Xmin,Xmax,Ymin,Ymax
2440  FRAME
2450  X=0
2460  FOR I=1.0 TO In
2470  X=X+Df
2480  Yp=Force(I)/Ymm
2490  IF I=1.0 THEN MOVE X,Yp
2500  IF I=1.0 THEN Xx9
2510  DRAW X,Yp
2520 Xx9:  NEXT I
2530 Dig: LORG 3
2540  CSIZE 3
2550  POINTER .5*Xmax,.5*Ymax
2560  DIGITIZE Ax,Ay
2570  GOTO Dig
2580 Left:  LORG 8
2590  Fa=-2*Df
2600  GOTO Lab
2610 Cent:  LORG 4
2620  GOTO Lab
2630 Rig:  Fa=2*Df
2640 Lab:  Nn=INT(Ax/Df)
2650  Fm=1.0
2660  IF Nn<=2 THEN Nn=2
2670  IF Nn>In-1.0 THEN Nn=In-1.0
2680  FOR I=1.0 TO 3
2690  N1=Nn-2+I
2700  IF Force(N1)>Fm THEN Nm=N1
2710  IF Force(N1)>Fm THEN Fm=Force(N1)
2720  NEXT I
2730  Nn=Nm
2740  Axx=Ax+Fa
2750  MOVE Axx,Ay
2760  LABEL USING "D.2DE,A,K,A";Force(Nn),"(",VAL$(Nn*Df),")"
2770  RETURN
2780 Cont:  SETGU
2790  LOCATE 12,122,6.5,7.5
2800  SCALE Xmin,Xmax,0,1.0
2810  MOVE Xmin,0
2820  DRAW Xmax,0
2830  CSIZE 2
2840  LDIR 0
2850  LORG 6
2860  Ix=0
2870  FOR Px=Xmin TO Xmax STEP Xtic
2880  IF Ix THEN Half
2890  MOVE Px,0
2900  DRAW Px,1.0
2910  MOVE Px,-.9
2920  LABEL USING "2D";Px
2930  Ix=4
2940  GOTO Nex
2950 Half:  MOVE Px,0
2960  DRAW Px,.6
2970  Ix=Ix-1.0
2980 Nex: NEXT Px
2990  SETGU
3000  LOCATE 10,11,8,90
3010  SCALE 0,1.0,Ymin,Ymax
3020  MOVE 0,Ymin
3030  DRAW 0,Ymax
3040  LORG 8
3050  FOR Py=Ymin TO Ymax STEP Ytic
3060  IF Py=Ymax THEN LORG 9
```

```
3070  MOVE 0,Py
3080  DRAW 1.0,Py
3090  MOVE 0,Py
3100  LABEL USING "D.D,X";Py
3110  NEXT Py
3120  SETGU
3130  LORG 6
3140  CSIZE 4
3150  MOVE 60,3
3160  LABEL "FREQUENCY  (Hz)"
3170  MOVE 2,20
3180  LORG 2
3190  LDIR 90
3200  LABEL "Rel. Force  (L.ton*L.ton/Hz)"
3210  !
3220  DUMP GRAPHICS
3230 Pltend:  EXIT GRAPHICS
3240  SUBEND
3250  SUB Table(In,Freq,Force(*))
3260  DIM Aa$[20]
3270  PRINT SPA(28),"COMPUTED FORCE SPECTRUM"
3280  Aa$="  Hz    Amplitude "
3290  PRINT USING "/,K,/,3X,4(17A,2X),/,K,/";RPT$("-",80),Aa$,Aa$,Aa$,Aa$,RPT$("
-",80)
3300  Dt=Freq/In
3310  Line=INT(In/4)
3320  FOR J=1 TO Line
3330  I=4*(J-1)+1
3340  F1=I*Dt
3350  F2=F1+Dt
3360  F3=F2+Dt
3370  F4=F3+Dt
3380  PRINT USING "3X,4(2D.3D,X,D.4DE,2X)";F1,Force(I),F2,Force(I+1),F3,Force(I+
2),F4,Force(I+3)
3390  NEXT J
3400  PRINT LIN(1),RPT$("-",80)
3410  SUBEND
```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